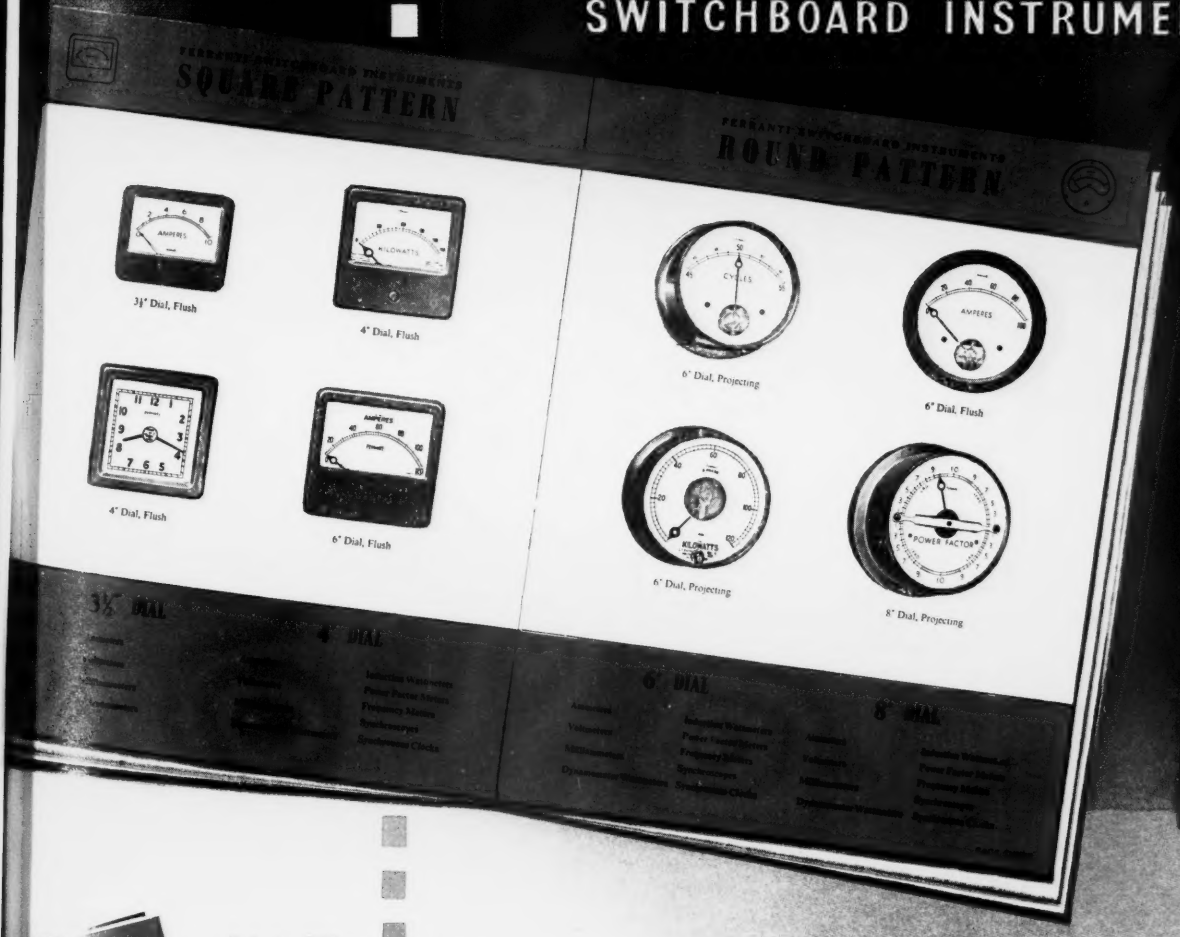
ELECTRICAL REVIEW

OVEMBER 1936 PRICE 1s 6d

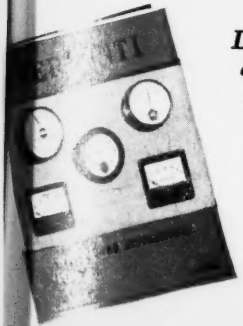
UNIVERSITY OF MICHIGAN
ENGINEERING LIBRARY

FERRANTI

SWITCHBOARD INSTRUMENTS



F FERRANTI



List IN30 and other catalogues supplied on request.

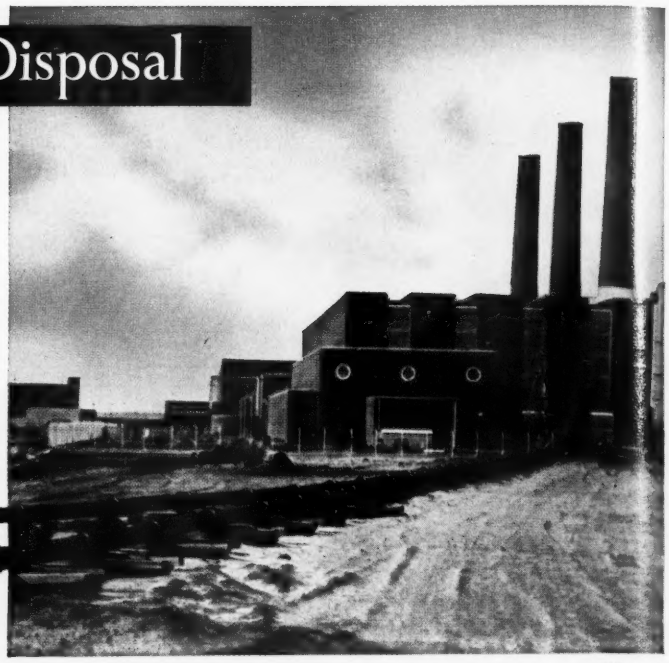
Illustrated above are several Ferranti Switchboard Instruments from a wide range. Shallow pressed steel cases 3¼", 3½", 4", 6" and 8" round or square dial. Projecting or flush mounting. All types of Ferranti switchboard instruments are also available in hermetically sealed cases.

FERRANTI LTD · MOSTON · MANCHESTER 10
Head Office and Works: HOLLINWOOD · LANCS
London Office: KERN HOUSE, 36 KINGSWAY, W.C.2

FI 145/4

Hydraulic Ash Disposal

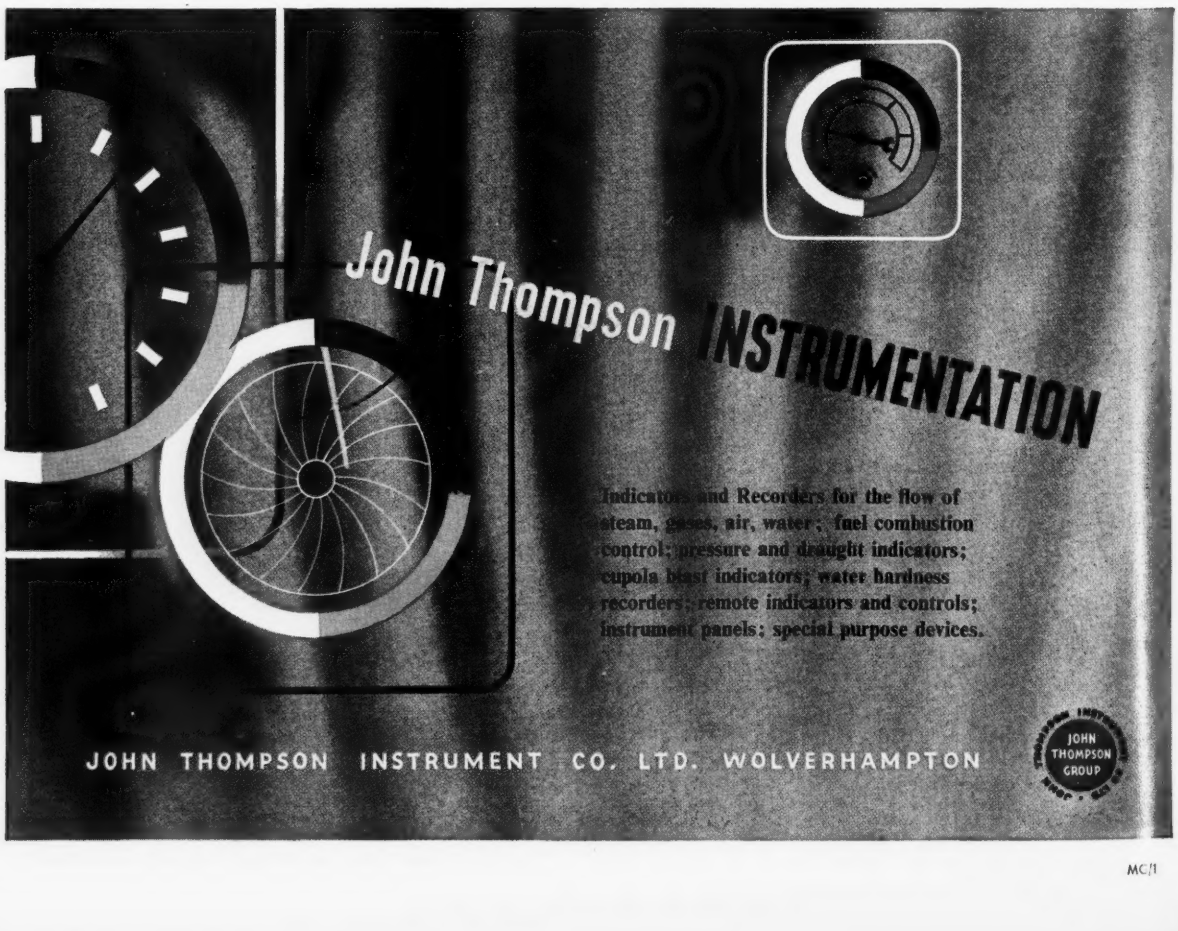
The John Thompson system of hydraulic ash disposal provides a clean and efficient method of ash and dust conveying of unlimited capacity. Hydraulic ash disposal has been applied successfully to both small shell boiler plants and to large water tube boiler installations with ratings of millions of pounds per hour evaporation employed in modern power stations. Boiler plant refuse may be piped to waste land or disused quarries by this method, or stored in sumps for final disposal. The illustration shows the Central Electricity Authority's Carmarthen Bay power station, where residues from a 3,600,000 pounds per hour boiler plant are handled by this system.



JOHN THOMPSON INDUSTRIAL CONSTRUCTIONS LIMITED
(Formerly B.V.C. Industrial Constructions Ltd.)
2 PRINCES ROW, BUCKINGHAM PALACE ROAD., LONDON S.W.1.
Telephone :VICtoria 9312. *Telegrams:* Induscon, Sowest, London. *Cables:* Induscon, London.

JOHN THOMPSON GROUP — THOMPSON INDUSTRIAL CONSTRUCTIONS LIMITED · JOHN

ICH/2


John Thompson INSTRUMENTATION
Indicators and Recorders for the flow of steam, gases, air, water; fuel combustion control; pressure and draught indicators; cupola blast indicators; water hardness recorders; remote indicators and controls; instrument panels; special purpose devices.
JOHN THOMPSON INSTRUMENT CO. LTD. WOLVERHAMPTON
JOHN THOMPSON GROUP

MC/1

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

23 NOVEMBER 1956

In This Issue

943 A FIRM FOUNDATION
945 ELECTRICITY IN THE SUDAN
951 WELDING OF ALUMINIUM
954 COMBUSTION ENGINEERING
955 VIEWS ON THE NEWS
956 LETTERS TO THE EDITOR
957 INDUSTRY AND THE HOUSE
958 PARLIAMENTARY REPORT
960 PERSONAL AND SOCIAL
963 SPECIAL INDUCTION MOTORS
964 CALDER WORKS PLANT
970 PUBLIC WORKS EXHIBITION
971 REGISTRATION AND INSPECTION
972 LONG-DISTANCE RADIO-TELEGRAPHY
973 ACTIVITY IN CHINA
975 INDUSTRIAL NEWS
979 GENERATION AND DEVELOPMENT
981 NEW ELECTRICAL EQUIPMENT
982 FINANCIAL SECTION
986 NEW PATENTS
987 CONTRACT INFORMATION
988 NEXT WEEK'S EVENTS

117 *CLASSIFIED ADVERTISEMENTS*
128 *INDEX TO ADVERTISERS*

VOLUME 159 ✧ NUMBER 21

Eighty-Fifth Year of Publication

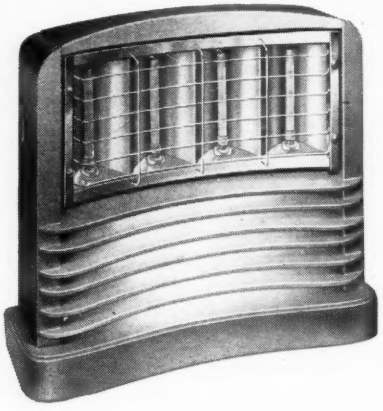
FRIDAY ✧ PRICE 1s 6d

Editorial, Advertising and Publishing Offices : Dorset House, Stamford Street, London, S.E.1. Telegraphic Address : "Elecrev, Sedist, London." Code : ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription : Home and Overseas £4 10s 0d : U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

Keep the home fires selling!

No. 555 Masterberry

3 kW wide-angle radiator elements. Can be supplied with log effect. Two recessed switches and special safety guard. Warm silver finish.
Retail price: £15.17.6. (+ p.t. £6.19.4.)



No. 333 Masterglow

2 kW wide-angle heat reflector assembly. Lower louvres give out steady glow independently of heating. Warm silver finish.
Retail price: £12.10.0. (+ p.t. £5.9.8.)

Attractive new designs, backed by hard-selling advertisements in the home interest magazines and national newspapers. This can be a better season than ever if you are ready to meet the steadily rising demand for electric heating—ready with Berry's Magicoal and Raydair.

Write for counter leaflets to:

Berry's

ELECTRIC MAGICOAL LTD

Touchbutton House, Newman Street, London, W1
Telephone: MUSeum 6800

Cambridge METER-TESTING POTENTIOMETER

and accessories

7594

This robust potentiometer complies with the specification for Standard Potentiometers as laid down by the Electricity Commission under Section 2 of the Electricity Supply (Meters) Act, 1936.

The potentiometer current can be standardised quickly at any time without disturbing the settings of either the main dials or the range switch. Temperature compensation for the standard cell is fitted in the form of a calibrated circular slide-wire. The galvanometer key makes two successive contacts, the sensitivity being reduced for preliminary adjustment.

Ranges. 0 to 1·8 volts and 0 to 0·18 volts (1/50th or 1/100th can be provided if required).

Resistance. 10 ohms per volt.

Accuracy. To 0·0001 volt on normal range. Inter-range accuracy is 0·01%.

Standard Cell Circuit. Covers temperature changes from 10° to 30° C. for cells of e.m.f. between 1·01850 and 1·01870 absolute volts at 20° C.

Write for Sheet No. 295X for further particulars

CAMBRIDGE INSTRUMENT CO. LTD.
13 GROSVENOR PLACE, LONDON, S.W.1
WORKS: LONDON & CAMBRIDGE

ELECTRICAL REVIEW

23 November 1956 Vol. 159 No. 21 Established 1872

A Firm Foundation

CALDER HALL nuclear generating station was built in record time for a power plant of any kind and considering the fact that the work involved was of a pioneering nature entailing the development of numerous new techniques, often under field conditions, the successful completion of the plant represents an outstanding achievement of British engineers. Despite the comparatively short time in which this plant has been designed and built, the work has in no way been skimped or rushed. Much careful thought has been put into the design of all aspects of the plant and many alternatives for each item involved were investigated and their relative merits evaluated before the final designs were chosen. This involved a vast amount of work but it will undoubtedly provide a firm foundation on which designs for future plants of basically similar type can be based. Realising the value of this work the British Nuclear Energy Conference has organised a symposium on the Calder works nuclear power plant which is taking place in London this week and about 20 papers are being presented under the headings of general design, technical research problems, engineering design, light and industrial engineering, and future developments. Some of the papers were summarised by us last week and the others are dealt with in this issue.

The Calder Hall reactors are heavy, cumbersome and expensive in capital cost per kW but they are inherently safe, they use natural uranium as a fuel, and their construction makes use of materials which have been in routine production for a considerable time and of techniques which are either well established in themselves or are normal developments of established techniques. Furthermore, reactors of this type can produce power at a cost comparable with that of a modern station using conventional " fossil " fuels. In engineering plant which has to be sold to industrial operators these are solid and vital advantages and at the present time the graphite-moderated gas-cooled reactor is the only type of nuclear power plant for which these claims can be made.

Looking back across the years it is evident that the weight per h.p. and capital costs fall with the passage of time for all types of prime mover and there is no reason to anticipate any different pattern with nuclear power stations. As experience grows and as better techniques and materials are developed higher initial temperatures in the heat cycle will be achieved, giving greater outputs and higher thermal efficiencies. Higher gas pressures in the cooling system will be used to achieve lower gas circulating costs. Better heat exchanger surfaces will be developed and greater specific ratings will thereby

be attained. All these and other improvements will lead to reductions in capital cost.

The importance of such reductions must be appreciated in the light of the fact that in a conventional power station about 75 per cent of the cost per unit of the electricity sent out represents fuel and operating costs and only 25 per cent is accounted for by capital charges. In nuclear power stations, on the other hand, over 60 per cent of the cost per unit sent out arises from capital charges. In the opinion of Sir Christopher Hinton, who delivered the first paper of the symposium, the merits of the Calder Hall type of reactor and the potential improvements which could be made in its design are such that plants of this type will still be built 25 years from now.

AUSTRALIAN IMPORT DUTIES

Last week we reported a trade agreement between the United Kingdom and Australian Governments one aspect of which was an undertaking by the Australian Government to continue to accord preferential treatment to imports of goods from the United Kingdom. But at the same time it was given freedom to modify the margins of preference over goods from other countries and it appears that the effect may be to narrow those margins; in the case of the scheduled electrical items there could be a reduction of $7\frac{1}{2}$ per cent which would amount to a concession to this country's competitors.

At the same time the Australian Government promises to limit the protection by means of import duties given to Australian manufacturers. It undertakes to afford such protection "only to industries which are reasonably assured of sound opportunities for success on the basis of the relative cost of economical and efficient production." Protective duties are not to "exceed a level that will give United Kingdom producers full opportunity of reasonable competition."

How these undertakings will work out in practice remains to be seen but on the face of things the position of United Kingdom suppliers does not seem to have been improved.

THE N.R.E.I.C.

After thirty-two years of operation the National Register of Electrical Installation Contractors is to be wound up at the end of the year, giving place to the new National Inspection Council for Electrical Installation Contracting (whose cumbrous title will no doubt be abbreviated to N.I.C. in due course). The N.R.E.I.C. was an organisation which, through no fault of its begetters and sustainers, never quite attained its aims. The Registration Board was unable to raise sufficient money to give the Register the widespread publicity which was essential to its success: in short, the public did not know about it and registered contractors were too thin on the ground to make a national impression. Its end really came when the Electrical Contractors' Association withdrew its support for what it considered to be an ineffective organisation, but it lingered on until the new National Inspection Council was set up.

Although the Register failed fully to achieve its object it probably had some influence in raising the standard of electrical installation work. At all events honour is due to those who devoted so much time and trouble to the cause. We may make particular reference to the late Mr. P. V. Hunter, who was chairman of N.R.E.I.C. practically throughout its existence, and Mr. F. W. Purse, who at the time of his death last December was the honorary director.

EACH TO HIS TRADE

An old question was revived at a recent meeting of ironmongers at Liverpool: whether it was safe for ironmongers to sell electrical appliances when they had nobody on their staff capable of handling them. The president of the National Federation of Ironmongers, to whom the question was put, thought that it was desirable to have a member of the staff who was qualified to give technical advice and was able to renew iron and kettle elements. Rather appositely, at the same meeting, the president mentioned the handling of ironmongery by departmental stores, saying that ironmongers were the people with the knowledge which equipped them to handle locks and lock furniture and black ironmongery, etc., and that side of the trade could never be properly dealt with by the stores. There must be a moral in this we think.

PULVERISED FUEL SAMPLING

Although the iso-kinetic sampling of pulverised fuel devised at the Fuel Research Station, Greenwich, six years ago has proved its value for occasional tests, it has been found that regular use of the principle in power stations called for more robust and simpler portable equipment that would make regular sampling less laborious. The apparatus and procedure developed by the Central Electricity Authority is described in detail in a manual produced by the Generation and Operation Branch of the Chief Engineer's Department.

Investigations carried out by C.E.A. chemists (Mr. W. Robert Jones of the South Wales Division and Mr. N. Smart of the Brighton stations) appear to indicate ways in which comparable results can be secured as between various plants and tests with fuels of high or low inherent moisture.

CREDIT WHERE IT IS DUE

In the monthly journal of the Amalgamated Engineering Union, under the heading "Public Ownership Succeeds Again," it is said that it was "a fine boost for public enterprise when Calder Hall sent current coursing into the electricity supply system for the first time." Without in any way diminishing the credit due to the Atomic Energy Authority for its great achievement, we feel it necessary to insist that Calder Hall is also "a fine boost" for private enterprise as well. The A.E.U. should be well aware of the prodigious tasks which have been undertaken and achieved by the manufacturers and constructors of the nuclear reactors and heat exchangers and associated equipment at Calder Hall. It is a rather foolish prejudice which prompts the union to withhold credit where it is certainly due.

Description of New Steam Power Station in Khartoum and Survey of Public Utility Developments

By C. A. BRITTON,
O.B.E., M.Eng., M.I.C.E., M.I.E.E.*

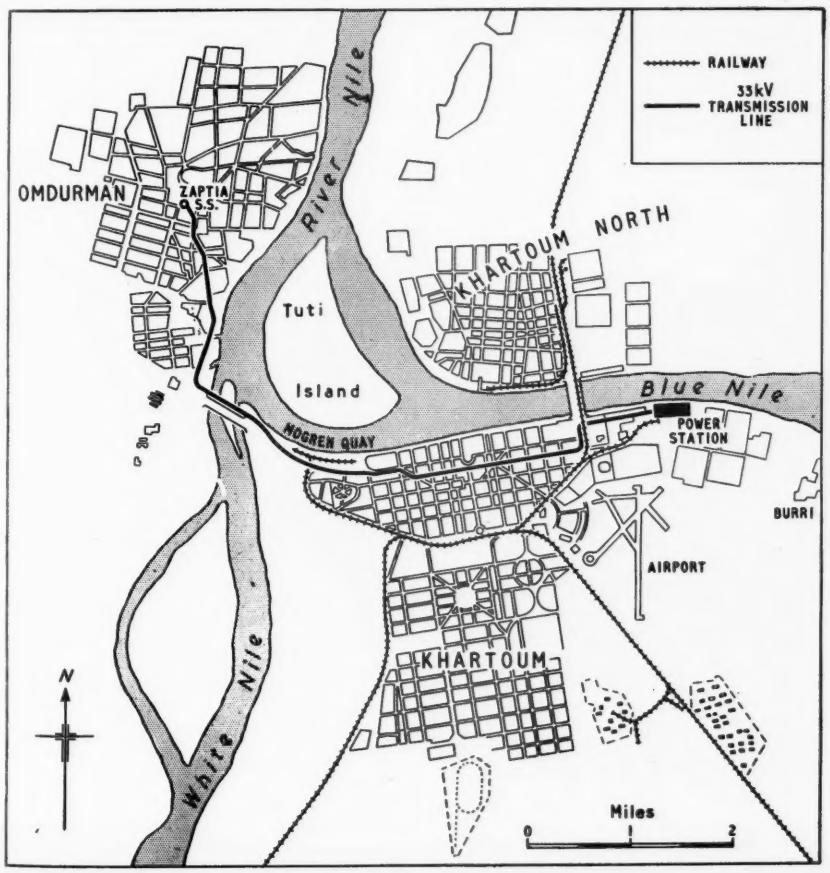
Electricity in the Sudan

ELECTRICITY and domestic water supplies were first introduced into the Sudan under the British Administrator in 1908. By 1925 the administration of the country was on a firm basis and the time was ripe for the introduction of modern services in the capital, Khartoum, and the adjoining towns of Omdurman and Khartoum North. This included a bridge over the White Nile, modern waterworks, electrical installations and inter-urban transport.

The provision of these amenities was beyond the financial capacity of the Sudan Government and a group of British companies was formed consisting of the Prudential Assurance Co., Ltd., the English Electric Co., Ltd., Dorman Long & Co., and Callender's Cable & Construction Co. (later British Insulated Callender's Cables, Ltd.). These founder member companies negotiated an agreement with the Financial Secretary of the Sudan Government, Lt. Col. G. E. Schuster, C.B.E., M.C., for the necessary capital, technical advice and operating organisation to be provided through the formation of the Sudan Light & Power Co., Ltd. This company was formed in January, 1925, and the first board of directors consisted of the following representatives of the group and the Sudan Government:—Lord Meston, K.C.S.I. (chairman), Col. F. J. Byrne, C.M.G., Sir T. O. Callender, Kt., Sir George E. May, K.B.E., Mr. P. J. Pybus, C.B.E., Lt. Col. G. E. Schuster, C.B.E., M.C., and Mr. P. Horsfell (secretary). The management of the company in the Sudan was carried out by a resident general manager under the direction of the board in London. For secretarial, technical and purchasing services the Power & Traction Finance Co., Ltd., was employed.

This organisation was unusual in that all the physical assets of the public services as and when provided, became the property of the Sudan Government for which the company acted solely as managing agents. This agreement was terminable in 1955 and provided for the later develop-

* Managing Director, Sudan Light & Power Co., Ltd.



Map of area supplied by Khartoum generating station showing route of the new 33 kV Omdurman feeder

ment of public ownership of the services they managed.

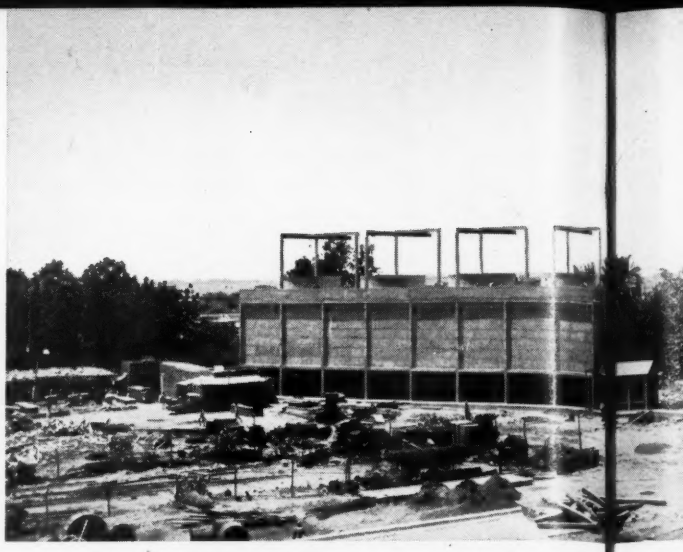
In meeting present-day problems and planning for the future, a number of interesting technical problems have arisen. During the war the electrical services operated by the company suffered from lack of development to meet expanding utilisation. The size of the electricity undertaking and the latent demand for power was such that in the three towns it was necessary to rebuild the whole of the existing installations and extend to cover new building areas in the surrounding district, and cater for increasing industrial development. Now the public services have been brought completely up-to-date and extended to meet present needs. Plans have also been made to allow for future expansion.

The rate of development since the war is indicated in Table I and by 1960 electrical demands are estimated to reach 14 MW. This rate of increase is expected to continue for some years to come, and demands for large blocks of power are envisaged in other areas throughout the country.

By 1950 it was evident that generation by diesel prime movers had reached practical economic limits and it was decided to employ steam turbo-alternators for the next stage, such plant to be brought into operation for the 1956 peak demand, estimated to occur in October. In the intervening period, plans for extension by diesel alternators continued. The generating station is 300 yd south of the Blue Nile at the eastern end of Khartoum 1,250ft above sea level. Nearby are the waterworks, reservoirs and associated installations. The diesel engine installation consists of 14 generating sets and these are summarised in Table II. Two types of engine are used: Q type Fullagar engines of the two-stroke vertically opposed piston type, running at 250/273 r.p.m., and multiple-cylinder V type diesel engines, running at 750 r.p.m. Both types are of English Electric manufacture.

Engine circulating water is cooled by " Premier " wooden natural draught cooling towers to the south of the station. The five original Q type Fullagar sets generate at 3 kV and one of the first actions in extending the generating station from 1946 was to replace the existing switchgear by 6·6 kV gear of higher rupturing capacity and provide 3/6·6 kV unit transformers for the alternators.

Subsequent engine installations generated at 6·6 kV. The combined control and switch room is at first floor level in an annexe on the south side of the main engine room,



and English Electric type OLC manually operated, horizontal isolation, metalclad oil circuit-breakers have been employed.

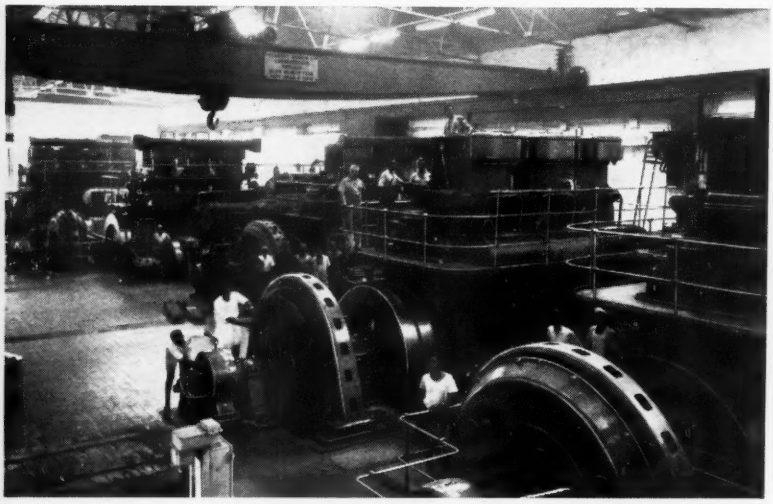
In designing the steam extension it was decided to generate at 11 kV and to cater for the increased density of load in the distribution system by providing an 11 kV network. It was also decided that the immediate installation should consist of two 5 MW turbines with an additional 10 MW set to be in operation for the peak load of 1959. It was necessary to consider the total installed capacity of generating plant as a single unit, the steam turbo-alternators to be used as far as possible as base load sets, the diesel plant being used to meet morning and evening peak demands. As the demands increased, additional steam plant would be installed and the diesel engines become wasting assets.

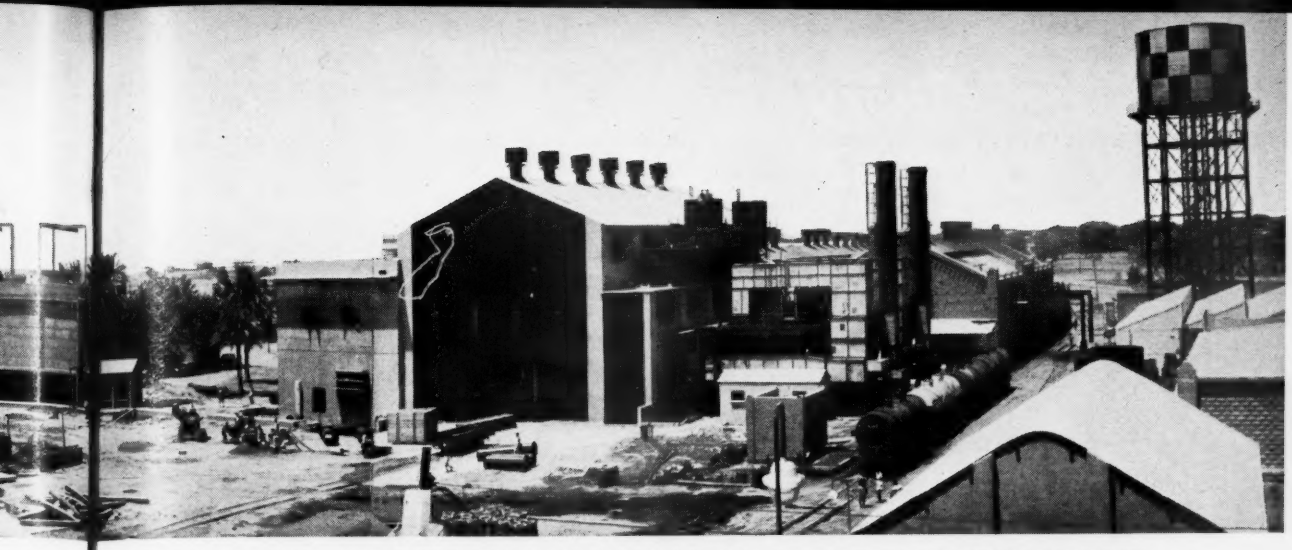
At the inception of these immediate extensions, it was decided to lay out the site for an ultimate maximum generating capacity of 50 MW. It was also decided to build a new central control room and arrange the diesel plant 6·6 kV switchgear for solenoid closing. It would be connected to the new 11 kV switchboard through 6·6/11 kV tie transformers so that current generated from either the diesel station or the steam station could supply feeders from either the 11 or 6·6 kV switchboards.

Entrance to the now completed station is on the south side. The tie transformers and switchgear rooms are respectively to the left and right on the ground floor while above them on the first floor is the control room on the left and administrative offices on the right. To the north lies the main turbine hall and auxiliary bay, situated directly to the east and opening into the main diesel engine room. The turbine hall is 58ft wide by 108ft long and has brick-panelled steel framing with a pitched roof covered with corrugated asbestos sheeting. Ventilation is by Robertson Thain fans at the apex of the roof. The two 5 MW turbo-alternators have their axes parallel to the end of the station, but the future 10 MW set will be arranged longitudinally. An electric overhead travelling crane, capable of handling the heaviest lift of a 10 MW set, is installed.

An operating floor 18ft above basement level allows for both the 5 and 10 MW sets to be at the same level; basement level corresponds closely to the surrounding ground level and the adjacent diesel engine room. The boiler plant is outdoors to the north of the turbine hall and operation is from a platform running longitudinally 7ft 10in above basement level adjacent to the outside wall of the auxiliary bay.

General view of the interior of the existing diesel generator station





Panoramic view of Burri power station showing mechanical draught cooling towers, turbine hall and boiler installations

The English Electric direct-coupled turbo-alternator sets are single-cylinder impulse type machines running at 3,000 r.p.m. and operating under steam conditions of 435 lb/sq in and 735 deg F at the stop valve, with a vacuum of 28·5in at m.e.r. There are three stages of bled steam feed heating, giving a final feed water temperature of 273 deg F at m.e.r. (292 deg F at m.c.r.). Main auxiliaries for each set comprise two electrically driven full duty condensate extraction pumps, one direct contact de-aerator heater pump and one full duty two-stage air ejector. For each turbine, a George Kent gauge panel and a grouped contactor starter board (Contactor Switchgear, Ltd.) for the control of auxiliary motors associated with the turbine, are situated at the steam end of the set facing into the turbine hall.

TABLE I

	1945	1953	1955
Installed generating capacity, kW ...	4,050	10,435	12,565
Maximum demand, kW	2,350	6,800	9,150
kWh generated	9,285,770	23,928,117	35,098,283
Consumers connected...	5,290	12,716	14,893
Capital expenditure (cumulative), £E	215,859	1,185,579	1,943,800
Gross revenue, £E	133,969	443,862	585,630

For cooling the condensers there is a bank of Davenport mechanical induced draught cooling towers of ferro-concrete construction. The bank consists initially of four cells on the south side of the station. There is a circulating water pump house at the north end of the tower bank which accommodates three Drysdale 16in vertical spindle pumps, each capable of handling the water quantity for one condenser at maximum continuous rating. Make-up water for the tower ponds and raw water for the evaporators is filtrate drawn from the town water supply and the chemical additives adopted are "Dispersol T" for supplies to the evaporator and "Santobrite" for the circulating water.

Mechanical Plant

There are two oil-fired boilers of the Babcock & Wilcox integral furnace, bi-drum water tube type, arranged for non-basement setting, each with a maximum continuous rating of 68,000 lb/hr. One boiler unit of equivalent rating is provided for each turbine set, generating steam at 450 lb/sq in and 750 deg F at the superheater outlet, from a final feed water temperature of 292 deg F at m.c.r. One Weir electrically driven feed pump is provided for each boiler with a common emergency steam driven pump, all connected to common feed suction and delivery headers; Copes automatic feed water regulators are fitted. The duplex fuel oil pumping and heating unit with one electric and one steam driven standby pump serves the oil-firing range and each boiler front has four "Y" jet burners with steam atomisation.

The constant speed i.d. and f.d. fans are in the open adjacent to the self-supporting steel chimneys. An air heater is provided and draught control is by dampers manipulated by Lockheed hydraulic controls. Each boiler has a Bailey Meters control panel and there is a contactor panel for the draught plant, both on the firing platform facing the boiler fronts. Boiler feed water is treated by continuous injection of sodium sulphite and caustic soda, in addition to an intermittent injection of phosphate into the boiler drums. Superheated steam from both boilers is passed through 7in mains to a common 7in/9in header which will provide interconnection with future plant.

Heavy fuel oil is unloaded from rail tank wagons by Hamworthy positive displacement pumps and stored in two 1,660 ton tanks, supplied by Whessoe, Ltd. The same pumps are used for transferring the oil to 30 ton service tanks, which in common with the main tanks are fitted with steam heating coils.

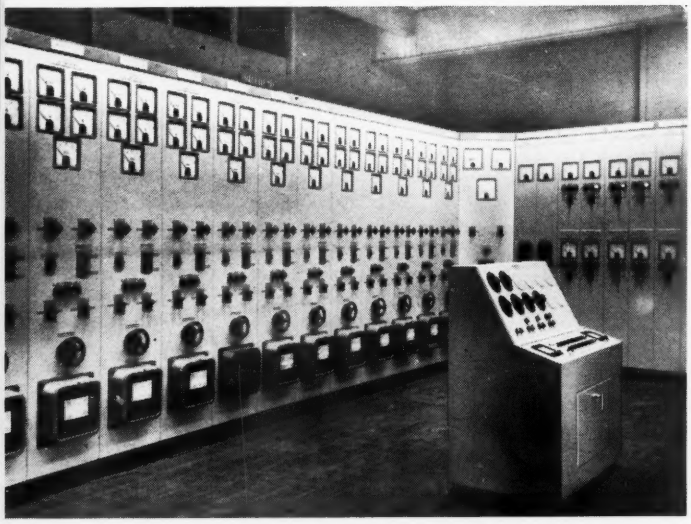
Control Room

The interior of the control room follows modern practice, with recessed fluorescent lighting overhead and a system of forced ventilation, maintaining a plenum of filtered air to exclude dust and sand. The centralised control board

TABLE II.—DIESEL GENERATING PLANT INSTALLED IN BURRI POWER STATION

Set No.	Year of installation	English Electric engine type	Speed r.p.m.	Site rating b.h.p.	Generator rating kW	Generation voltage kV
1	1925	4Q Fullagar	250	645	460	3·0
2	1927	6Q ,,	250	1,115	750	3·0
3		6Q ,,	250	1,115	750	3·0
5	1930	6Q ,,	250	968	690	3·0
4	1937	4Q ,,	300	845	500	3·0
8	1950	6Q ,,	273	1,274	905	6·6
12	1951	16 SV blown	750	1,456	1,000	6·6
11		16 SV ,,	750	1,456	1,000	6·6
7	1953	8Q Fullagar	273	1,702	1,210	6·6
10		16 SV blown	750	1,456	1,000	6·6
9		16 SV ,,	750	1,456	1,000	6·6
13	1954	16 SV ,,	750	1,456	1,000	6·6
6	and	16 SV ,,	750	1,620	1,150	6·6
14	1955	16 SV ,,	750	1,620	1,150	6·6
Total installed capacity				17,372	12,565	

Sets 1 to 8, 13 and 14 in main building. Sets 1 and 4 taken out of service on commissioning of steam plant.



Central control room for diesel generator sets, turbo-alternators and feeders

is in the form of a broad " U " and comprises 30 panels for the control and indication of 38 circuits. They are arranged to group the 6·6 kV feeders and alternators together, and the eight 11 kV panels form a second group at one end. The 6·6 kV and 11 kV bus section switches are controlled from panels at each corner of the board, which carry maximum demand indicators, recording voltmeters and busbar voltmeters for the respective diesel and steam stations. All control equipment is of English Electric manufacture.

To reduce the size of the control board, a separate floor mounted mimic diagram faces the control board with separate relay and metering panels at each end. A scheme of summation metering affords centralised indication of the total loads on each station while Ferranti printometers with maximum demand indicators record the station loads at 30-min intervals. Also on the metering panels are summation kWh meters integrating the units generated in each station, and kWh meters for all 6·6 kV feeders which have been transferred from the old control room.

As a central feature a communications console and a controller's log desk face the control board. The telegraph receivers local to the diesel generator sets, turbines and boiler fronts are controlled from the console including a new telephone system linking various outstations with the control room. A portable synchronising trolley has been adopted which includes a semi-automatic means of preventing the closure of either alternator circuit-breakers or bus tie transformer circuit-breakers unless the appropriate voltage and frequencies are within one per cent of synchronism. Other equipment includes an Everett Edgcumbe master frequency meter with independent standard time and frequency time dials and a small wall-mounted mimic diagram of the station l.v. auxiliary system with semaphore indication of h.v. and l.v. circuit-breakers and l.v. section isolators.

Control Cabling

Below the control room is a cable compartment with a headroom between joists of 5ft 6in laid out with multi-tier cable trays following the general layout of equipment above. Here are marshalled some 269 pilot cables outgoing to the old control room, diesel generator sets, and new switchgear and apparatus in the steam station. All the pilot cables are multi-core p.v.c. insulated, aluminium sheathed, served and braided.

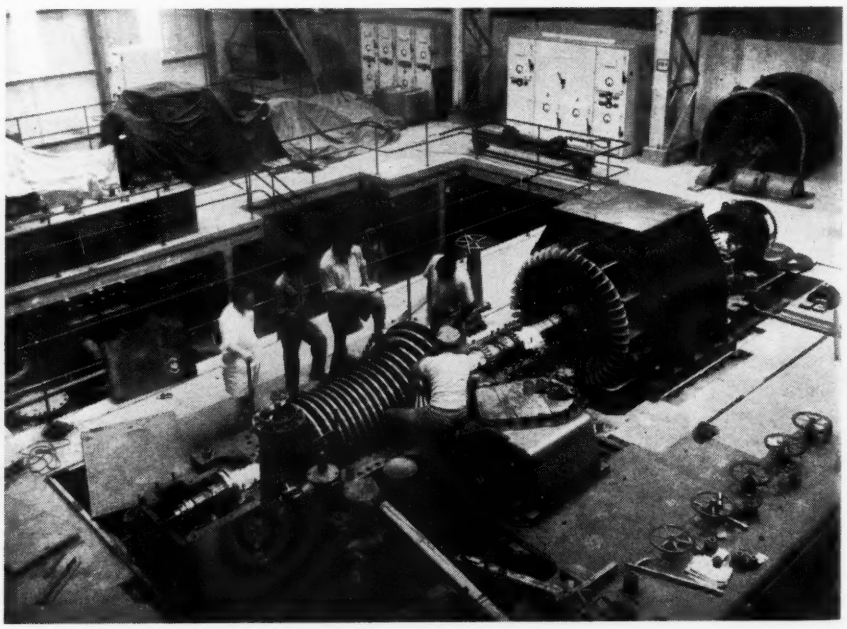
All this cabling was supplied by British Insulated Callender's Cables, Ltd., but the installation was undertaken by the Sudan Light & Power Co.'s own staff and involved a total of some 13,000 yd. The scheme of centralised control involves 1,100 cores in some 143 cables linking the new and old control rooms and the cable formations are carried in trays and in cleats supported on a gallery along the north side of the new annexe and bridging across to the old switch and control room. This main run of cables is situated in the open and access is by a central walkway between the cable formations.

The dry climatic conditions obviate the need to protect cables installed in the open and also the necessity of sealing the terminations; B.I.C.C. compression glands have been used for making-off the ends.

Distribution System

After the war extensive earth resistance tests were undertaken in Khartoum and as a result it was decided to undertake a major reconstruction of the 3 kV/230 V three-phase unearthed distribution system. The new 6·6 kV earthed neutral system consists of a ring main linking seven new main substations equipped with English Electric type OLX switchgear, transformers and B.I. tailless unit distribution boards. At the same time it was decided to

One of the 5 MW steam turbo-alternators during construction



adopt the standard earthed 415/240 V distribution network.

In designing the new h.v. distribution system selected cables were uprated to 6·6 kV and used, where suitable, as tie interconnectors and radial feeders to smaller substations. New h.v. ring main systems have been established in Omdurman and Khartoum North and the local substations brought up to date.

Khartoum North has a rapidly growing industrial load, while Omdurman has a large domestic, commercial and growing light industrial load. The load density in Khartoum has reached such proportions that it has become necessary to change the h.v. system voltage to 11 kV and many dual ratio 11 kV/6·6 kV/415 V transformers have been installed preparatory to the complete change-over.

Work is now progressing on a new e.h.v. 0·1 sq in underground feeder to Omdurman to pick up the load at the Zaptia receiving station. The laying and jointing of the 33 kV aluminium sheathed, impregnated pressure cable is being carried out by the Sudan Light & Power Co., Ltd., with the assistance of British Insulated Callender's Construction Co., Ltd., the accessories being supplied by B.I.C.C. The route includes a crossing of the White Nile adjacent to the bridge, for which 950 yd of submarine cable were employed.

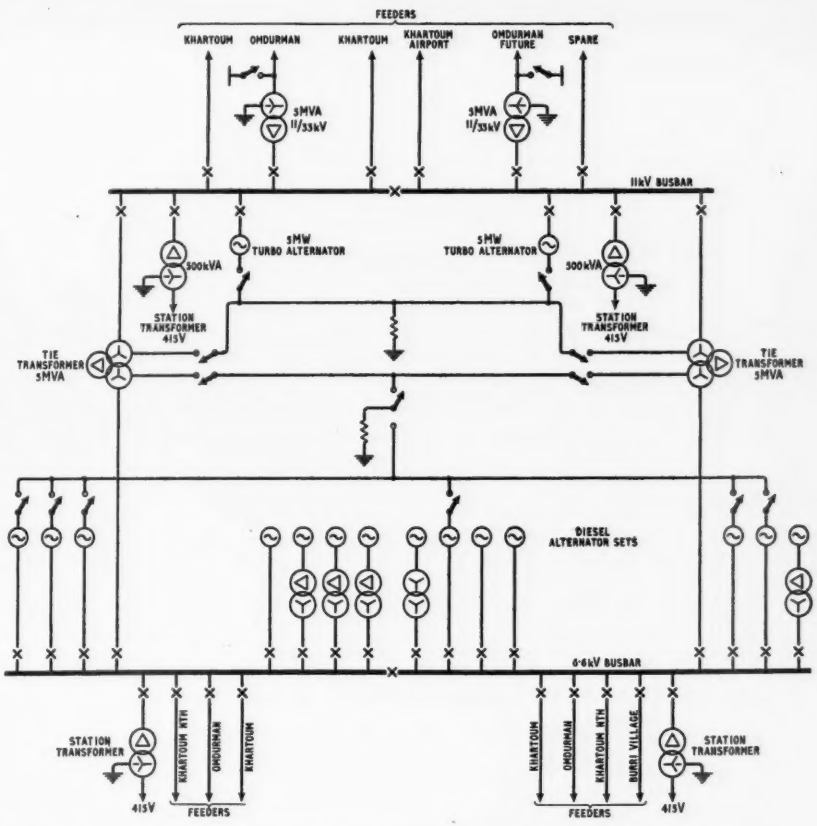


Fig. 1.—Arrangement of the combined busbar systems for the diesel and steam generating stations

This feeder has a capacity of nearly 10 MVA but initially it will be energised through an English Electric, 5 MVA, 11/33 kV outdoor transformer, with on-load tap changer controlled by a line drop compensating relay and steps down through a dual voltage 33/11/6·6 kV transformer, connected for 6·6 kV operation until the Omdurman distribution system is changed over to 11 kV. Terminal equipment comprising transformer, isolators (Line Equipment, Ltd.) on steel towers, tubular copper busbars, gas control kiosk and single-core lead sealing ends, are in outdoor compounds, designed to accommodate a duplicate set of equipment for a projected second 33 kV feeder to Omdurman.

Protection

The 11 kV turbo-alternators are protected by a circulating current system which is instantaneous in operation and the generator overcurrent protection has an inverse definite minimum time characteristic. For the bus-tie transformers, restricted earth fault protection and inverse definite minimum time overcurrent relays are provided for both 11 kV and 6·6 kV windings. Feeder protection, including the 11/33 kV transformer and the station transformers, consists of inverse time overcurrent and earth fault relays with intertripping between the Omdurman feeder 11 kV circuit-breaker and a phase-to-phase fault throwing switch on the 33 kV side of the step-up transformer.

A simple form of busbar protection is applied to the 11 kV switchgear, which is split into three zones, each connected through a frame leakage current transformer to earth. The trip contacts of the three discriminating relays are connected in series with the contacts of a "check" relay operating from a current transformer in the station neutral earth, thus providing an economic check system against an inadvertent busbar shut down.

In affording busbar protection to the 6·6 kV switchboard, the bus section switch has been included in each of the other two zones and a differential system of protection is applied by adding appropriate current transformers to each circuit-breaker. In addition, reverse power relays have been provided for the diesel generator sets.

Until a second 33 kV Omdurman feeder is commissioned, the loads on the Zaptia switchboard are arranged with the more heavily loaded feeders on one side of the section switch and normally supplied via the 33/6·6 kV step-down transformer. In the event of a shut down of either the 6·6 kV or 33 kV feeders, the load on the affected bus section is picked up by the automatic closure of the section switch, subject to the discrimination of certain fault conditions. Inter-tripping between the incoming 6·6 kV circuit-breaker to the 33/6·6 kV transformer and a phase-to-earth fault throwing switch on the 33 kV side, prevents feed-back from the power station end.

Busbars and Switchgear

The combined busbar systems for the diesel and steam generating stations is shown in Fig. 1 which indicates the arrangement adopted for integrating the new steam plant into a common power system without exceeding the

maximum fault duty of existing installations. Briefly, the existing switchgear was uprated to 150 MVA and two 5 MVA, 6·6/11 kV, 7 per cent reactance tie transformers were interposed between the corresponding bus sections of each power station switchboard.

It was decided that duplicate busbar switchgear was unnecessary for the steam station and English Electric Class OLD, metalclad, single-busbar switchgear was chosen. The new board consists of 13 panels, including bus section, equipped with horizontal isolating oil-immersed circuit-breakers suitable for a maximum fault duty of 350 MVA. Additional feeders for the three towns' distribution systems will be connected to the 11 kV switchboard and before the steam station was commissioned the new switchboard was energised by switching in one of the station tie transformers and bringing into operation the first of these feeders. Separate Brown-Boveri automatic voltage regulators are provided for each alternator. For normal operation the 6·6 kV and 11 kV will be earthed on the tie transformers but arrangements are also made for earthing some of the diesel sets and both the steam sets under abnormal operating conditions.

Low-Voltage Supplies

Three-phase 415 V supplies are derived from two 500 kVA station transformers of English Electric manufacture, feeding into the left-hand and right-hand sections of a 20 circuit single-busbar Reyrolle switchboard. The Class D1 oil-immersed horizontal draw-out metalclad switchgear is arranged for manual closing, and outgoing feeders are controlled by Class HH switch and fusegear with a fault duty of 33 MVA.

The busbars are sectionalised by an off-load isolator and protection on the circuit-breakers comprises restricted earth fault and directional overcurrent relays. Duplicate feeders to each grouped contactor starter board controlling station auxiliaries are taken from opposite sides of the bus section. It is planned to install two further 500 kVA station transformers and repeat this arrangement for the future 10 MW set. To achieve flexibility, provision is made on each end of the station l.v. switchboard for future interconnection through isolators and single-core cables. Fire extinguishing media for h.v. switchrooms and transformer bays are CO_2 and pre-mixed foam, respectively.

Future Organisation

Coincident with the work of the Sudan Light & Power Co., the Sudan Railways were developing electrical power installations in the principal railway centres, and the Public Works Department continued to develop power and water supplies in other areas of the country on a smaller scale such that at the present time electricity supply undertakings operate in the towns of Atbara, Wadi Halfa, El Obeid, Kosti, Malakal, Juba, Wau, Kassala, Ed Damer, and Port Sudan in addition to the towns of Khartoum, Omdurman, Khartoum North and Wad Medani.

The increase in agricultural development and in particular the wealth now coming to the Sudan through the increased prices for cotton and cotton seed, gum arabic, sesame, ground nuts, hides and cattle, has revolutionised the finances of the country since the war and power requirements are now of an importance comparable to other developing countries.

A satisfactory conclusion of the Nile waters negotiations will result in further extensive agricultural developments. This will only be possible provided power development keeps pace with demands. The Government is aware of this and is desirous that a competent organisation should exist to advise and carry out such schemes as are necessary.

As no indigenous fuel resources are available in the country, the possibility of harnessing the waters of the Nile and the utilisation of waste products from the cotton growing industry are being actively considered by the Ministry of Irrigation and Hydro-Electric Power and the Sudan Gezira Board. The Sudan Light & Power Co., being experienced over the past 30 years, and operating the major power installation in the country, is being called upon to play an important part in assisting the Government and any future organisation set up.

The agreement covering the Sudan Light & Power Co., ended in December, 1955, but it has been extended temporarily, and the Council of Ministers have decided that the time is now considered propitious to determine the future organisation which will fulfil the functions of the Sudan Light & Power Co., the Wad Medani Light & Power Co. and the other supply undertakings in the Sudan. It has further been realised that the management and development of public utilities is hampered by the lack of adequate legislation defining the statutory obligations of public undertakings and the rights and obligations of consumers.

To ensure proper development investigations will have to be instituted into the present utilisation of power throughout the country, and to forecast the nature, extent and disposition of power requirements in the future. The Government of the Sudan is considering all these matters.

It is further realised that, with the expansion envisaged, the Sudan will be unable to provide, for many years to come, sufficient numbers of professional and technical personnel from its own nationals to install, operate and organise such an important technical service as electrical power.

It is a measure of the Government's foresight that it has agreed to attractive terms and conditions of employment ensuring that men of experience, and of adventurous and enterprising character, who accept such service in the Sudan, may look to an amenable, interesting and productive career. It is not unreasonable to expect that the Sudan will go to those countries for assistance which are prepared to supply trained and experienced personnel, at the same time as they are providing heavy engineering plant.

All the indications are that the immediate future in the Sudan will be a time of rapid expansion and reorganisation of the electricity industry on sound lines.

Switchgear for steam generating station controlling turbo-alternator set, tie transformer and feeders

Welding of Aluminium

Equipment for the Inert Gas Arc Process

By F. P. Hahn, M.Eng., A.M.I.E.E.*

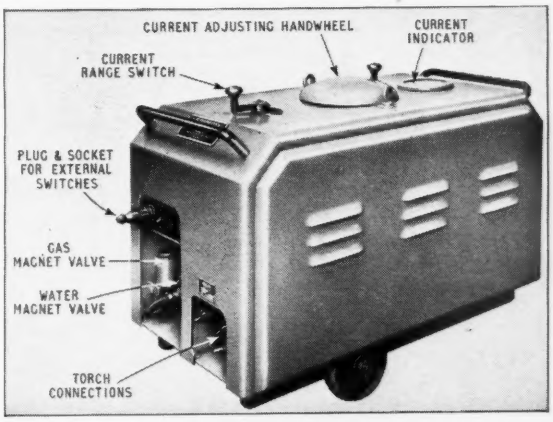
IN the inert gas arc welding process an arc is drawn between the workpiece and a non-consumable electrode, usually of tungsten or a sintered compact having tungsten as the major constituent, under a blanket of inert gas. Either argon or helium may be used for shielding, but in this country helium is not available in sufficient quantity and argon must be used. It has been found that, for the welding of light alloys, an alternating current arc is most advantageous and for industrial use an equipment is required that will allow this arc to be struck, maintained and broken as required. As argon gas is relatively expensive, automatic control of the flow of gas is desirable to reduce operating costs to the minimum.

An a.c. arc between tungsten and aluminium in an atmosphere of argon is characterised by a higher arc voltage when the aluminium is emitting electrons than when the current is flowing in the reverse direction. Further, while the arc strikes very easily at the beginning of the electrode negative half-cycle, a much higher voltage is necessary to strike the arc at the beginning of the electrode positive half-cycle.

Unless measures are taken to correct them, these two factors result in partial rectification of the current which has two deleterious effects: firstly, the arc lacks cleaning power, as it has been found that it is the emission of electrons from the weld surface that breaks up the oxide film and produces a clean weld pool and, secondly, the direct current component tends to produce saturation of the welding transformer core.

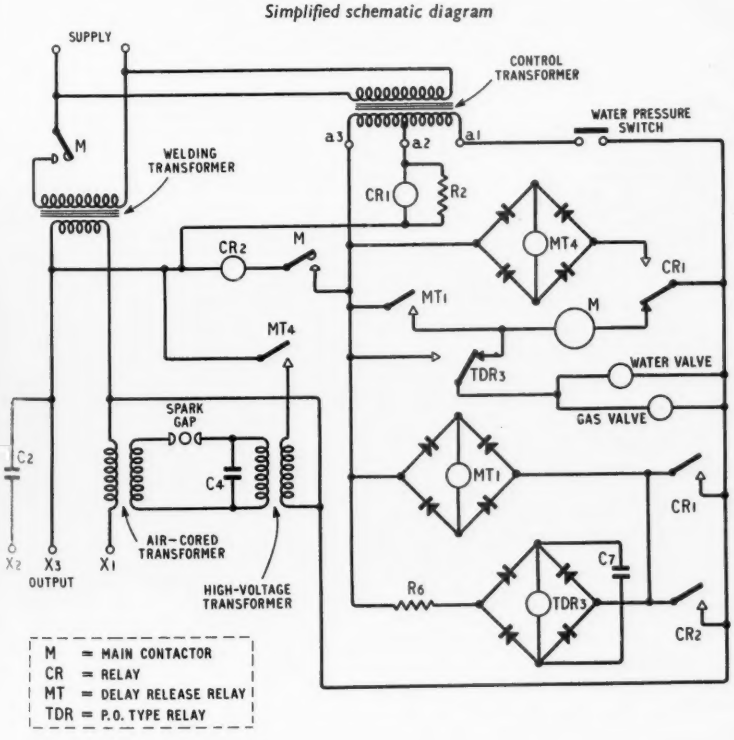
Various manufacturers have adopted different methods of overcoming these difficulties such as, for example, the use of a continuous high-frequency high-voltage superimposed across the arc, but the use of condensers in series with the arc has now gained wide acceptance and the equipment which is described in this article employs this method.

The Metrovick equipment employs a moving coil transformer of the same type as that used in the "Thermac" arc welding sets and for welding light alloys a capacitor bank having a total value of 25,000 microfarads is connected in series with the arc, and by this means it is possible to prevent any direct current component flowing. The transformer has an open circuit secondary voltage of 100 and the design provides a rapid rate of rise of restriking voltage after the current zero so that, with the exception of the thinner gauges of very pure aluminium, there is no difficulty in maintaining a steady arc without resort to high-frequency or electronic arc stabilisers.



The complete welding equipment

Simplified schematic diagram

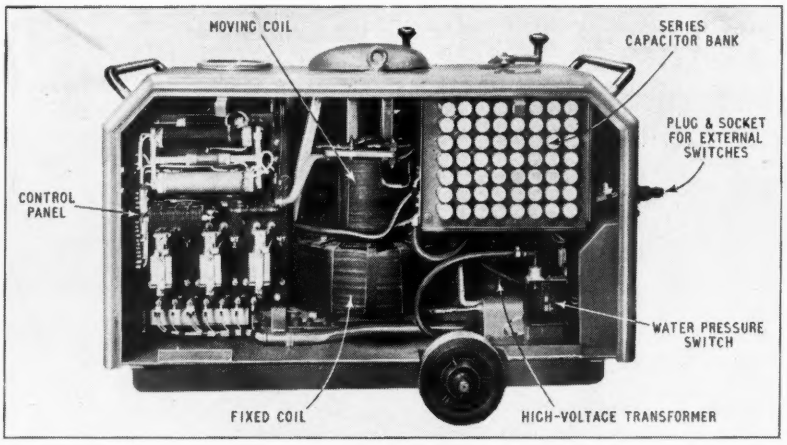


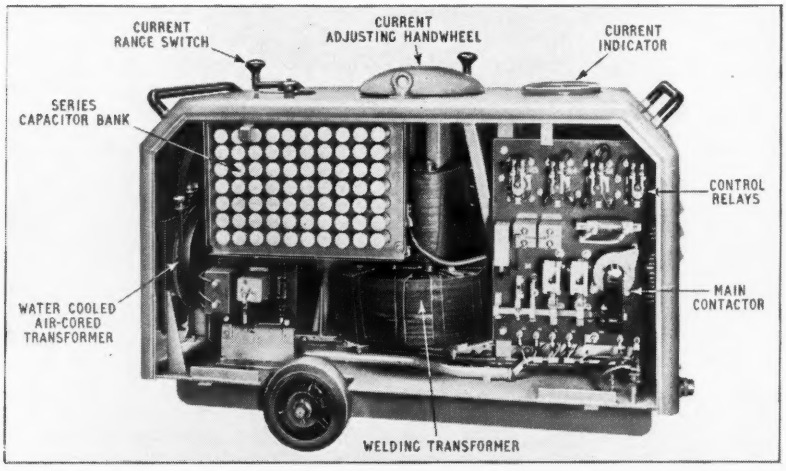
Current Adjustment

The use of a moving coil transformer permits stepless adjustment of welding current which can be varied during welding, if necessary; and by shaping the core as shown in the photograph the change of current for a given movement of the handwheel is arranged to be approximately proportional to the current, thus avoiding a cramped scale at the low current end of the range.

When using the inert gas arc welding process the operator must at times adjust the electrode and there is also the danger of touching the electrode accidentally during non-welding periods. If the operator is wearing dry gloves and is in a normal situation this involves no risk,

* Metropolitan-Vickers Electrical Co., Ltd.





Side views of the equipment with covers removed

but under adverse conditions the transformer open circuit voltage could result in a severe shock. To avoid this danger, a contactor is connected into the primary supply to the welding transformer and control relays ensure that it is opened within a very short period of the operator breaking the arc and only closed again when the arc is just about to strike. Thus, the open circuit voltage is never on the electrode for more than a second and danger of shock is almost completely eliminated. This arrangement is called the "Idlematic" circuit. By switching off the welding transformer during non-welding periods the consumption of electric power is reduced.

Starting the Arc

In normal metallic arc welding the arc may be started by touching the electrode on to the workpiece. If, however, this is done when welding light alloys by the inert gas arc welding process a small amount of aluminium is picked up by the electrode and rapidly diffuses through the tungsten when it becomes molten. The aluminium-tungsten alloy is a less efficient electrode material and becomes more fluid than pure tungsten, in consequence of which there is a risk of tungsten being transferred across the arc, resulting in a dirty and contaminated weld.

To avoid this trouble the arc is started by a high-voltage high-frequency spark when the electrode is a short distance from the workpiece. This high-frequency spark is generated by a simple spark gap oscillator, as shown in the circuit diagram, consisting of a transformer with a secondary voltage of 4,000, a double spark gap with tungsten points, a capacitor and an inductance which forms the primary of an air-cored transformer used to inject the high-frequency energy into the welding circuit. Such an oscillator, while simple and reliable, generates a wide range of frequencies and can cause considerable radio interference. To reduce this to the absolute minimum the circuit is arranged so that the high-frequency is not switched on until the electrode is in the right position to start the arc and, as the primary of the high-voltage transformer is fed from the secondary of the welding transformer, the high-frequency voltage disappears immediately the arc strikes, since the output of the high-voltage transformer is insufficient to break down the spark gaps when the circuit is energised at the arc voltage.

The air-cored high-frequency transformer has three pancake coils, the centre coil being wound from flat strip and forming the primary. The two outer coils must carry the welding current in addition to the high-frequency current and are, therefore, wound from an oval section copper tube through which water is passed. The insulation between primary and secondary is subjected to a routine test at 9 kV.

When the equipment is switched on and water has been turned on so that the water pressure switch has closed, a low voltage is applied across the welding transformer primary by section a1-a2 of the control transformer secondary and this voltage appears between the electrode and the earth terminal. The current which flows in series through resistance R2 and the welding transformer secondary is insufficient to produce enough volts across R2 to pull in relay CR1. When the operator desires to start the arc he touches the electrode down firmly on to the workpiece. The full voltage across a1-a2 will then appear across R2 and CR1 pulls in. CR1 energises relays MT1 and MT4 which have a delayed release of approximately one second produced by "slugged" coils and MT1 relay energises the magnet valves WV and GV via the normally closed contact of TDR3, thus turning on the inert gas and cooling water. The main contactor M does not pull in as the CR1 contact in series with it is open.

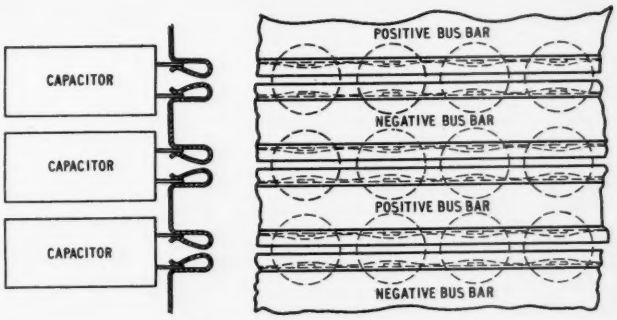
When sufficient time has elapsed for the flow of inert gas to be established the operator lifts the electrode slowly from the work and CR1 immediately drops out, closing main contactor M which applies voltage to the primary of the welding transformer. As MT4 is closed, the high-frequency voltage appears, the arc strikes and the high-frequency voltage disappears. The voltage on the coil of CR2 is the difference between the arc voltage and the

voltage across a1-a3 of the control transformer and it pulls in and remains in as long as the arc is established. R2 re-energises TDR3 and also MT1 before this relay has time to fall out. In the meantime, capacitor C7 reaches its full charge and TDR3 pulls in, taking over control of the gas and water valves from MT1. MT4 falls out, positively disconnecting the h.f. circuit.

As the operator breaks the arc, the voltage on CR2 becomes the difference between the control voltage and the welding transformer secondary voltage and this is insufficient to hold it in. When CR2 drops out main contactor M also drops out, due to MT1 being released, but the gas and water valves are held open for a sufficient period to allow the electrode to cool below red heat in an inert atmosphere by the time taken for the charge on C7 to leak away. This avoids loss of tungsten due to oxidisation.

The method of operation just described is ideal for most types of work since the operator can position the electrode with his helmet raised and start the arc exactly where he wants to. Further, he has no need to operate an auxiliary control and, as argon gas does not start flowing until the electrode is in the correct position for starting the arc, minimum consumption of expensive gas is ensured. However, two alternative methods of arc starting are provided as standard in the equipment.

When tacking up light structures they may be disturbed if the electrode is touched firmly on to them and provision is made for the connection of an auxiliary switch to bring on the open circuit voltage, high frequency, inert gas and cooling water. When the operator is using this method of starting the arc he holds the electrode approximately $\frac{1}{2}$in from the workpiece and then depresses the auxiliary switch which can be in the form of a foot- or hand-operated push-button switch. This turns on the supplies and the electrode is then moved towards the work and the arc strikes when the gap is $\frac{1}{8}$in-$\frac{1}{4}$in. When the arc is broken the open circuit voltage disappears and gas and water are turned off after a delay period whether the switch has or has not been released, and if it has not the switch must be released and re-depressed to start the arc again.



Arrangement of capacitor bank

The other method is used when the component lends itself to mechanised welding and the electrode is arranged to move at constant speed a fixed distance from the work. Two push-buttons can then be connected to the set, arranged so that the depression of one strikes the arc and depression of the second extinguishes it, but leaves gas and water flowing for the controlled delay period.

As the capacitor has to handle the full welding current it is necessary that it should have a large surface area for heat dissipation. To achieve this, more than 100 separate cans are used suitably mounted in a supporting framework. To avoid a multiplicity of soldered connections the individual capacitor units are plugged into busbars which are formed from phosphor bronze. In addition to facilitating assembly, this form of construction allows quick replacement of a unit in the event of failure in service.

Owing to the high reactance necessary in a welding transformer to ensure stability of the arc, the power factor is low. To minimise the effect on the supply mains, power factor correction capacitors are fitted as a standard feature and to avoid a low leading power factor during non-welding periods they are disconnected from the supply at the same time as the welding transformer by the "Idlematic" circuit.

NUCLEAR REACTOR SAFETY

THE advent of power generation from nuclear fission on a substantial scale brings with it the production of large quantities of radioactive materials as a by-product. The presence of these materials provides the major hazard associated with the operation of a nuclear reactor, and the necessity for absolute self-containment under all conditions of operation, including accident, provides one of the major requirements of design. If nuclear energy is to provide, as it is intended, a substantial part of the nation's electricity, then it is vital that nuclear power stations shall be capable of being built close to densely populated areas without creating any additional hazard to the inhabitants. Thus, the radioactive fission products must not in any circumstances be released in an uncontrolled manner.

At a meeting of the North-East Coast Institution of Engineers and Shipbuilders on 16th November a paper which discussed some of the safety considerations relating to nuclear power reactors was read by Mr. C. D. Boadle. He said that nuclear reactors exhibited many characteristics which were not unlike those of other power producers. Some provided valuable self-regulating features in a reactor, while others involved the risk of rapid power surges which were capable of causing serious damage, unless regulated by a control and monitoring system provided for the purpose.

For many types of reactor, the final guarantee that radioactive materials would not be discharged following an accident must be provided by complete containment in a gas-tight building or pressure shell.

The two characteristics of nuclear power plant which provided most operating hazards were the large in-built reactivity, which, if released in an uncontrolled manner, resulted in a very rapid rate of power rise, and the high rates of heat release from reactor cores—many times those prevailing in other thermal machinery. It was evident, therefore, that in the event of any mishap the detecting and emergency measures must be capable of working rapidly and reliably. Furthermore, any conceivable failure of the supervisory system should return the reactor to a safe state, or at least give a warning of a failure. The latter was of particular importance in marine applications, where failure of the main propulsion at short notice might be just as hazardous for the vessel as a mishap to the reactor.

At present it was considered prudent to contain the entire system in most power reactors in a further pressure vessel or gas-tight building. Although this measure might appear extreme it provided the required guarantee against the accidental release of active material, and future experience alone would demonstrate the necessity for such a course. Future systems, employing continuously processed liquid fuels, offered substantial rewards in terms of safety, as they provided a method of dispensing with the need for a large amount of reactivity and at the same time provided substantial stabilising temperature effects.

Combustion Engineering

Generating Plant Efficiencies : Dust Collection Equipment

OPENING a technical meeting of the London Section of the Combustion Engineering Association on 14th November, Mr. R. Nichol (section chairman) summarised papers presented at the World Power Conference in Vienna last June, with ensuing discussions, in their bearing on the work of the Association. A common aim, he observed, was how to meet economically a world growth in demand for energy of 7 per cent per annum with the increasing efficiency required on account of diminishing natural resources. In many of the 50 or so countries represented at the Conference the limited financial means available created difficulties in view of the slow return on capital invested in power plants.

World reserves of coal were expected to last for 280 years, but varied widely in their location; thus, in Great Britain the period seemed to be 100 years. An important difference between countries was in the cost of mining, which was high here in comparison with the U.S.A. and New Zealand. Proved reserves of oil were said to be equivalent to 30 years' needs, but earlier estimates had been continually revised upwards.

Steam Station Trends

Efficiency of electricity-generating steam plant was approaching the technical limit of about 43 per cent. In the U.S.A. steam conditions of 5,000 lb/sq in and 1,112 deg F and a heat rate of 8,000 B.Th.U./kWh were envisaged. Exit-gas temperatures of 200 deg F in the U.S.A. compared with about 300 deg F usual here, but corrosion might be troublesome in the former case. Developments in water treatment for high-pressure boilers were encouraging. No technical difficulties were expected to attend the use of higher steam pressures, but they would call for a considerable extension of automatic control. Gas turbines had not fully realised expectations and the most promising line of advance appeared to be a combination of steam and gas cycles. Back-pressure sets were more frequently employed for heating big blocks of flats on the Continent than in the United Kingdom, but the use of pass-out turbines was being largely discontinued, one reason being inability to standardise them.

The impact of nuclear energy was not expected to be fully felt for many years, but almost every country was building reactors for power production or for research. Great Britain was, of course, the first country to build full-scale power reactors, but the U.S.S.R. had had a 5,000 kW unit running for two years without any ill effects from radiations. The U.S.A., with ample resources of coal, oil, water and natural gas, was in no hurry and was engaged on research into the best type of reactors for its purposes. An "organic" reactor was mentioned as a possibility in industrial sizes; its internal pressure was said to be only 30 lb/sq in and its resultant steam conditions 415 lb/sq in and 550 deg F. Sodium as a heat-transfer medium was also being investigated there as well as in Britain. World uranium resources were estimated at 23 million tons, which would last as long as any other. Exploitation of other possible sources was generally regarded at present as uneconomic, but heat pumps were being used in U.S.A. power stations, where low-grade heat was available, to test their potentialities. Nuclear engineers were not regarded as different from others.

A survey of British dust collection equipment, with particular reference to the Clean Air Act, was presented by Mr. Alan Wilson (National Industrial Fuel Efficiency Service). The author referred to investigations by the Department of Scientific and Industrial Research, which divided responsibility for air pollution in the following percentages: railways, 17; factories, 34 apart from power stations (which added little to pollution owing to the highly efficient dust collection equipment installed); domestic chimneys, 41; miscellaneous, 8.

Dust from industrial boilers varied in diameter from one micron (millionth of a metre) to over 500 microns, compared with 100 to 300 of ordinary seashore sand. The finest emanated from pulverised-fuel firing of which, according to the Central Electricity Authority, 95 per cent was less than 100 microns and 5 per cent less than 5 microns.

A usual method of determining the percentage of coarser dusts according to size was by shaking a sample mechanically through a number of wire-mesh sieves in a series of diminishing sizes which graded them in accordance with B.S. numbers. Below 53 microns (B.S. No. 300) the main method in use was elutriation in which a sample was subjected to a rising current of air or water. Particles of known size were lifted from the sample in a ratio proportionate to their weight and the velocity of the air or water, and by running the container at varying speeds they were automatically separated into grades.

Technical particulars of five main types of dust-collection equipment with their advantages and disadvantages were considered, as follows: settling chamber; bag filter; cyclone, high and low loss; electrostatic; wet arrestor or scrubber. These constituted a wide variety of equipment to meet almost every need of industry. Fog density appeared to be markedly increased by the number of smoke particles, which acted as a nucleus around which dirty water droplets formed, obstructing light and damaging life and property.

Acknowledgment was made in respect of information supplied by the following companies:—Mechanical equipment: Air Control Installations; British Ceca Co.; Davidson & Co.; J. Howden & Co.; Mancuna Engineering; Peabody; Power Gas Corporation; Prat-Daniel (Stanmore); Sturtevant Engineering Co.; Thermix Industries; Tipton Tub & Tube Co.; Visco Engineering Co. Electrostatic equipment; W. C. Holmes & Co.; Lodge-Cottrell; Simon-Carves; Sturtevant Engineering Co.

Aluminium Conductors

IN view of the increasing use of aluminium conductors in insulated electric cables a new British Standard, B.S. 2791: 1956, has recently been issued. It provides a standard range of aluminium conductors suitable for use as alternatives to the copper conductors specified in B.S. 7, B.S. 480 and other British Standards for electric cables. The conductor sizes and strand formations given in this Standard are closely related to the existing copper sizes and have been chosen to meet the major needs of users. In most cases the resistance of the nearest equivalent copper conductor is within 10 per cent of that of the corresponding aluminium conductor. Copies of the new Standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 3s.

VIEWS on the NEWS

By REFLECTOR

"CITY AND GUILDS" is common currency in the technical education world and yet a great many people are unaware of its origin. Therefore it is useful to have a reminder of this in the current "City and Guilds Broadsheet." It was decided at a meeting in 1876 of representatives of the City of London Corporation and certain City Livery Companies that the Companies should adopt a plan for the promotion of education, and especially technical education, in London. Two years later the City and Guilds of London Institute for the Advancement of Technical Education was incorporated and it received a Royal Charter in 1900. The main purpose of the Institute was to carry on and extend the good work which had been done for centuries by the London Guilds in producing skilled craftsmen by their apprenticeship system which, it is claimed, made us the workshop of the world.

* * *

The transmission, both ways, of electricity between England and Scotland has been a regular thing for many years. Occasionally, it has been condemned by ultra-nationalistic Scots who have believed that England was the only beneficiary. Now an interesting further development is reported by the *Scottish Daily Express*. It is said that Berwick, which imports electricity from Scotland, is to export gas in exchange, for an area reaching to Eyemouth (Berwickshire). Will the aforesaid Scots consider this to be a fair exchange?

* * *

On Friday the last of the Edinburgh trams—eleven of them—made final ceremonial passage through the city and to mark the occasion Edinburgh Castle was floodlighted. The frugal Transport Department squeezed the last penny out of them, according to *The Times*, which reports that the full fivepenny fare was charged for the south-north journey.

* * *

When the lay Press wishes to impress its public it quotes the capacity of power stations in watts. It certainly sounds more startling to rate a power station at 200 million watts rather than 20,000 kilowatts or 200 megawatts. I suppose that the general public is not in a position to distinguish between a watt and a megawatt but the introduction of millions is likely to make a bigger impact. However that may be, I am surprised to see this method employed in a report on conditions in New Zealand published by the Board of Trade.

* * *

A correspondent of the *Farmer's Weekly* asked recently whether full power was being brought to the five 60 W lamps which he installed in five poultry huts. He explained that he had run over 100 yards of rubber-covered cable to the huts "behind lean-to buildings, supported by wires from the gutter brackets." He wanted to know whether he should use insulators at the support points. He was informed that if the cable was only a single wire it might produce a fall in voltage sufficient to make the lamps appear dim. It was doubted whether there was appreciable leakage from the cable "unless it is very old and the insulation is very bad." The reply went on:—

> "It is better practice to use insulators for stringing the cable, and if you are prepared to go to the expense you might install a new cable of thicker wire and mount it on insulators screwed on to the brackets."

I think it would be better practice still to install an out-of-doors run of more than 100 yards in a better fashion altogether.

* * *

I have seen a report to the effect that a Halifax trader has been refused permission by the Town Council to erect a neon sign, on the grounds that it would be prejudicial to local amenities. The business of the trader is described as "Funerals, Weddings, Coaches." Councillor Liley, who supported the erection of the proposed sign, said that efforts to brighten the town should be encouraged. Perhaps the Town Council also feels that, apart from spoiling local amenities, a constant reminder of the inevitable blazoning forth at night is not one of the best ways of "brightening" the town.

* * *

"Stima" is the staff newspaper of the East African Power and Lighting Group but I cannot discover from the issue before me what the name might imply; it looks like a set of initials. It contains a number of interesting notes on the doings of the companies and their staffs and among them I note the following which seems to be full of local colour:—

> "Imagine every native village lit up! Visualise the joy to a female Kikuyu as she exchanges her headband for an electric trolley! And see the happiness in the heart of every bibi as she dashes off the toto's smalls in the washing-machine and gaily frizzles up the posho on the latest infra-red."

* * *

Scientific tests on dynamos were sufficiently new seventy years ago to warrant a five-page report in the *Electrical Review* of 26th November, 1886, of a series of tests carried out by the Franklin Institute of the United States on seven different machines—four Edison and three Weston. The state of the art of dynamo design in those days is summed up in the following paragraph:—

> "Dynamos have frequently been built by 'guessing' at the proportions, constructing them, and then trying them to 'see what they will give.' If they then turn out (by chance) to give the electromotive force and current desired, the designer generally gets the credit for having made very correct 'calculations'; while if they give, for some unknown reason, quite different results, the manufacturer has to be consoled with the statement that 'it is not possible to calculate the parts of a dynamo.'"

"Undue Discrimination"

Electricity Charges to Industrial Consumers

By F. E. Sugden

IN the *Electrical Review* of 27th July there was a report of Lord Normand's judgment in reference to electricity charges in South Scotland. What is the legal significance of the House of Lords' decision so far as the consumer is concerned?

Briefly recapitulating the facts of the case: a consumer company complained that the Electricity Board, in fixing certain maximum demand tariffs for supplies of electricity for industrial purposes, had shown undue preference and undue discrimination against them as high voltage consumers to the advantage of low voltage consumers, in spite of the fact that the h.v. consumers were supplied with electricity at a lower fuel cost.

The case was based upon the provisions of the Electricity Act, 1947, section 37, subsections 3 and 8. Subsection 3 reads as follows:—" Subject to any directions of the Central Authority . . . the prices to be charged by Area Boards for the supply of electricity by them shall be in accordance with such tariffs as may be fixed from time to time by them, and those tariffs shall be so framed as to show the methods by which and the principles on which the charges are to be made as well as the prices which are to be charged, and shall be published in such a manner as in the opinion of the Area Board will secure adequate publicity for them."

Subsection 8 lays down that " an Area Board, in fixing tariffs shall not show undue preference to any person or class of persons and shall not exercise any undue discrimination against any person or class of persons, and the Central Authority shall, in exercising their powers under this section in relation to the fixing of tariffs and making of agreements by Area Boards, secure compliance by Area Boards with this subsection."

The Electricity Board considered that the consumer's claim should be dismissed as irrelevant, on the ground that undue preference and undue discrimination were not " undue " unless exercised for illegitimate reasons which the Electricity Board contended had not been pleaded by the consumer company.

Briefly, the result of this case was that the House of Lords considered that the company's claim against the Electricity Board failed. The claim was that the tariffs were illegal and *ultra vires* and of no force and effect; that the tariffs as applied to users metered at or above a voltage of 6 kV should be reduced; and that the Electricity Board should repay the company the sum of £10,000 with interest at the rate of 5 per cent per annum.

The House of Lords considered that the provisions of the Electricity Act of 1947 did not specifically deal with whether the Electricity Board had exercised undue preference or undue discrimination but whether it had exercised undue preference or undue discrimination for an illegitimate reason which, the Lords agreed with the Board, was not contended by the company. They further held that the main provisions of section 37, subsections 3 and 8, of the Act did not deal with the question of undue preference and undue discrimination in reference to the actual existence of the tariffs complained of by the company but the actual operation of the tariffs themselves. Other steps should be taken to have the tariffs revised.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Private Generating Plant

I READ with much interest Mr. S. G. Laidlaw's letter on a combined hydro-electro-mechanical installation in Scotland. The essential points are that (1) a system of energy storage which has proved effective in the past is now no longer economic, and (2) the source of mechanical power is essentially asynchronous, and of variable maximum output.

It is not stated how much energy is stored. The following alternatives may be possible:—(1) By using a modern turbine, the greater efficiency may permit all the factory power requirements to be met. (2) Conditions may be favourable for a pumped storage scheme: this would involve the installation of a pump and a h.p. turbine.

If these are not practicable, then the balance of power demand must come from either a private machine or the Hydro Board, who can be expected to charge an appropriate fee for their services. While an asynchronous water turbine-alternator set would operate satisfactorily, it would always draw its reactive kVA, relatively large for a slow-speed machine, from the supply, regardless of the direction of power flow. A part of this could be provided by static condensers, but not in excess of the no-load value.

An alternative method which would require less civil engineering work would be to interpose a rotary convertor between the mains supply and the existing d.c. generator, but this retains the limitations of the present waterwheel.

London, S.W.1. F. E. M. HARDY.

All-Electric House Costs

IF we are to believe the figures quoted for an all-electric house at Woking, 120 kWh per week costing eleven shillings for space heating and cooking, instead of proving that electricity is reasonably cheap it has completely proved the reverse.

Assuming 1 kWh per person per day, a well-accepted figure for an electric cooker, and assuming the family to be four people $4 \times 7 = 28$ kWh per week, leaving 92 kWh for space heating at a cost of 8·43 shillings.

92 kWh = $92 \times 3{,}412$ B.Th.U. = 313,904 B.Th.U.

A modern automatic type of boiler burning anthracite (13,000 B.Th.U./lb) at 80 per cent efficiency would require 30 lb of fuel which at £13 per ton = 3s 6d.

Slough, Bucks. P. J. HARMAN and J. B. SHORROCK.

INDUSTRY AND THE HOUSE

Economic Effects of Middle East Intervention

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

IT is not at all easy to resume in normal tones my accounts of Parliament from the industrial point of view. In ten or so years' experience of the Commons I have never known a period like the last few weeks when world affairs have dominated our thoughts and divided our feelings every moment of the day. Indeed, Suez and Hungary have dwarfed home events to such an extent that I suspect quite a few of my normally knowledgeable colleagues if questioned would be unable to give an account of the contents of the Queen's Speech, but would recommend the inquirer to read it.

However, before turning to legislation to come, it is as well perhaps to maintain the central theme of present days and discuss—as did the House last week—the economic consequences of the Middle East adventure or pacification (either word can be used according to political taste).

Strain on National Economy

Mr. Harold Wilson, Labour's "shadow Chancellor"—a description which his round and robust figure hardly deserves—argued in opening that even before Suez the country was on the verge of another autumn economic crisis. The gold and dollar reserves had seriously fallen back again despite the windfall from the sale of Trinidad Oil. In these circumstances Mr. Wilson felt that there was an obligation on the Government to tell the House and the country of the plans it had in mind to cope with the new strains.

The Suez expedition had to be looked at in a wider context than military costs alone. Increased freight charges due to war risks would have an effect on export and import prices and the blocking of the Canal would not in any case make the position of our overseas trade easier. Also, what was to be done about oil supplies and the certainty that dollars would have to be found from somewhere for additional American supplies? He estimated that Western Europe would need an additional 75 million tons of oil from the western hemisphere.

Returning for good measure to Mr. Gladstone, who was quoted by the Chancellor of the Exchequer in his Budget speech, Mr. Wilson asked Mr. Macmillan to remember some other words of that famous Victorian: "The expenses of war are a moral check which it has pleased the Almighty to place upon the ambition and lust of conquest." The vigour of these words from the past seemed to surprise Mr. Wilson when he read them as much as they did both sides of the House.

Mr. Macmillan did not rise at once to answer, but delegated this task to Mr. Maudling, who is now the Minister of Supply. Mr. Maudling is an extremely able man and can be relied upon to make lucid the most difficult of cases. Not that he would admit his was a difficult case to present. In fact, Mr. Maudling accused Mr. Wilson of being "far too gloomy to be accurate." In the first half of this year he said the country had a surplus of some £145 million, an improvement of £125 million on the same period last year. Exports in the first nine months were nine per cent up over last year and imports only one per cent up. That was the position before the Middle East intervention. What was the effect of that intervention? Mr. Maudling could only say that reserves were accumulated to deal with temporary difficulties and facing as we were temporary difficulties, it was not unreasonable to use them. The country would have no problem about "rebounding afterwards" because the fundamental trade and economic position was sound.

Refusing to be drawn too far on the oil situation, the Minister thought it would not be possible to assess the full extent of the damage until experts had reported. For the moment he could not say whether further action in addition to the Minister of Fuel and Power's plan for a voluntary reduction of ten per cent would be necessary. It was unreal to calculate the cost of the Government's Middle East policy without setting on the other side the great and lasting damage that would have been inflicted on the economy if the Government had not acted decisively and in time.

The debate was kept going by a series of back benchers, including several Scottish members, until Mr. George Brown wound up for the Opposition. He accused the Government of putting a brave face on what they knew was an extraordinarily grave situation caused by their own folly. Even *The Times*, which had given the Government so much support in their operations, had confessed in a leading article that Suez had yielded no gains at all comparable to the costs incurred. Could the Chancellor say what would be the effect of the blocking of the canal and pipelines? When would oil be flowing again? Was it correct that after the beginning of December the most Western Europe could expect was sixty per cent of normal oil supplies? When would the Government be obliged to end the present voluntary cut of ten per cent and introduce a full rationing system?

Chancellor's Reply

Finally, the Chancellor of the Exchequer rose. His intervention had been looked forward to with interest because hitherto he had taken no part in Suez debates, although it is rumoured that he is the strong man in the Cabinet behind the Prime Minister. Mr. Macmillan had let it be known that his speech would be short. The reason for this turned out to be that he had in mind more a defence of his political position than an account to the House of the economic future. This seems to be the present mood of the Government; they know that their policy has been, is, and will be under continual attack from the Opposition and are determined to see it through, come what may. This technique is probably unavoidable but it hardly makes for informed parliamentary discussion. Instead, the temperature all too quickly rises and emotion piles on emotion.

Amid uproar Mr. Macmillan cried that although he accepted it was the traditional duty of a Chancellor of the Exchequer to oppose expenditure which he knew would lead to economic troubles, he did not do so because he was convinced that history would prove in the end the Government to be politically right.

The Queen's Speech presents a moderate programme, unlikely in the main to arouse strong passions. Among measures affecting trade and industry are those regulating shop closing hours and giving statutory form to present

hire purchase and hiring restrictions. This last is an interesting innovation coming from a Conservative Government; in fact, there may be Government back benchers who will complain that to make temporary powers permanent is to accept the socialist arguments for physical controls.

Electricity Supply Reorganisation

The announcement that the Government intend to bring in a Bill for the reorganisation of electricity supply is of outstanding interest. The phrasing indicates that they are leaving themselves free either to add to or subtract from the Herbert recommendations as such. The indications are that the Opposition will oppose legislation on the grounds that it is unnecessary and also that the Government have already shown themselves incompetent to reorganise publicly-owned industries. However, once the main debates are out of the way the Committee Stage may yield many constructive suggestions for improving the everyday running of British electricity supply. Apart from the major political struggle and provided the Government continue to accept the principle of nationalisation, there cannot be major dispute between the two sides of the House over the kind of changes required. Both Government and Opposition at various times and in various ways have declared themselves for decentralisation and greater parliamentary control, and that is what I imagine the new legislation will be mainly about.

PARLIAMENTARY REPORT

IN the resumed debate on the Queen's Speech in the House of Commons, Mr. Harold Wilson said that our share in world trade was shrinking. In 1955 our exports did not keep pace with the expansion of total imports into the sterling area or with the rates of increase in sterling imports achieved by our main competitors. The Opposition had warned the Government that merely to squeeze workers out of the wrong industries did not mean that they would go into the right ones. The January-June figures showed that in the engineering and electrical industries, mainly producing plant and equipment for export and for priority capital investments in this country, the increase in employment was a miserable 8,000, but over the same period 40,000 people went into professional, financial and miscellaneous occupations. The final test of the Government's policy was investment. New industrial building authorisations in the second quarter of this year fell by 52 per cent, compared with the same period in 1955. In Germany they were up by 20 per cent. While we were cutting our investments, Germany was increasing hers.

Mr. R. Maudling, Minister of Supply, said that exports in the first nine months of this year were 9 per cent up on last year, while imports were only 1 per cent up. In October we had the highest level of exports ever recorded in one month and in spite of Mr. Wilson's forecast, this putting right of the balance of payments situation had not been achieved simply by putting a large check on the level of investment. In fact, investment in manufacturing industry for the first part of 1956 was 25 per cent above last year's figure. The present United Kingdom balance was much improved over last year's and was sound and healthy. The current balance of the sterling area was also encouraging.

Not only had Britain to face competition from the U.S.A., Germany and Japan, but there was undoubtedly developing a threat of commercial and industrial competition from the Soviet Union which should not be underestimated. Clearly, the first essential was the greatest possible investment in brain-power and equipment for British industry. The Government were pledged to an overdue programme of extending technical education and were doing much to encourage improvements in machinery and equipment.

Mr. N. Pentland said it had to be recognised by everyone that Britain's most important source of power for this century would still be coal and those who were looking at coal through spectacles covered with atomic energy dust were doing a disservice to the nation by suggesting that the atomic energy age was just around the corner. If to-morrow we had 25,000 men available we could put them straight into the coal mines.

Mr. Henderson Stewart, Under-Secretary of State for Scotland, told the House of the Government's progress in encouraging industries to go to Scotland. Among the new projects which he mentioned was a new Government-financed factory to be provided at Airdrie for Pye, Ltd.

Mr. F. Lee declared that the Government's progress in increasing facilities for technical education was not fast enough. He asked firms in the engineering industry to do more to assist in the production of technologists, whose work would be of the greatest help to them in the future.

U.K.-Australian Trade Agreement

An account of the new United Kingdom-Australian trade agreement which will be drawn up early next year and will operate initially for five years was given by the President of the Board of Trade, Mr. Peter Thorneycroft. In reply to Mr. Bottomley, he said it was the Australians' desire that the preferential margins should be reduced. It was a source of gratification, however, that the principle of mutual preference was preserved, and that on over 90 per cent of our trade with Australia there would be a guaranteed minimum margin of 7½ per cent on producer goods. In answer to Mr. Amery, he said the Australians' view was that, particularly when duty-free capital goods were coming in, it was unreasonable that we should continue to ask for as high a preference as we enjoyed before. Therefore, for quite practical reasons of their own, a desire to get their producer goods cheaper, they proposed to us a lowering of their preference margins.

Mr. Russell asked if the Minister was satisfied that this agreement would help the British export trade and that it would not suffer the same fate as exports to Pakistan had suffered since the Pakistan agreement was made.

Mr. Thorneycroft said he thought British exporters should be sufficiently competitive to hold the market with the advantage of the new preference margins.

Mr. Bottomley said the Minister must carry a heavy burden of responsibility for this adverse trade decision, particularly as it gave greater benefits to our competitors.

Geneva Tariff Negotiations

In a debate on the recent tariff negotiations held at Geneva under the ægis of the General Agreement on Tariffs and Trade, Mr. A. R. W. Low, Minister of State, Board of Trade, said that in the course of consultations with British industrialists, some industrial associations had expressed their fear of dumping, but this danger should not affect the general level of our tariffs. The way to deal with them was through anti-dumping and countervailing duties and the Government proposed to ask Parliament to give them powers to impose such duties.

Mr. Cyril Bence said that machine tools should be completely removed from the field of tariffs. They were not mass-produced, except for the small ones, and were becoming increasingly specialised. There was a great need for new design and new technology in the industry.

Mr. Gordon Walker said he doubted if it was worth going through such complicated negotiations and paying high-powered people to achieve so very little when it was clear that the impetus behind G.A.T.T. was dying.

Even countries like Ceylon were openly attacking G.A.T.T. and saying that they would go over to bilateral agreements. Australia was saying the same. It had been estimated that the concessions would scarcely make £5 million worth of difference to British trade.

Mr. Low, replying to the debate, said that the gains we got from the U.S. in concessions amounted in terms of 1954 trade to £59 million; our concessions covered trade of £48 million. As for Mr. Gordon-Walker's figure of £5 million of extra trade generally, he did not know; but the negotiations would give a better opportunity over a wide field of trade to British exporters. So long as they were competitive they would be able to export more to the world.

Hydro-Electric Development in Basutoland

Mr. William Griffiths asked the Under-Secretary of State for Commonwealth Relations what plans had been made for the extension of water-power in Basutoland.

Lord John Hope said that in Northern Basutoland it had been suggested that certain rivers might be dammed to provide electricity for Basutoland, and electricity and water for the Orange Free State. These possibilities were being investigated. In Southern Basutoland two surveys of the Upper Orange River had been made with a view to using the river to produce electricity, but more information was needed before conclusions could be reached. No concessions had been granted for the exploitation of uranium in Basutoland.

Technical State Scholarships

Mr. Chetwynd asked the Minister of Education whether he would increase the number of Technical State Scholarships.

Sir David Eccles said he was considering the number of such scholarships. Any change would be announced in time for the next academic year.

Southend Railway Electrification

The Minister of Transport and Civil Aviation (Mr. Harold Watkinson) told Mr. Parker that electrification of the railway from Shenfield to Southend was now nearly complete and it was expected that through electric trains between Liverpool Street and Southend would start running on 31st December. Detailed planning was proceeding for the electrification of the line from Fenchurch Street to Tilbury and Southend. Contracts had been let for certain preliminary engineering works and work had started at several sites.

Patents Bill

The Patents Bill, to provide for extending time limits for certain purposes relating to applications for patents and other purposes, was read the first time in the House of Lords.

Henley Students' Conversazione

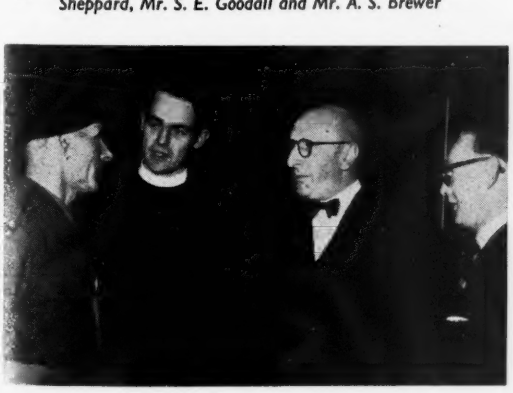
THE fourteenth conversazione of the Henley Education Scheme took place at the Woolwich Polytechnic on Saturday last when the students and guests were received by Mr. E. J. Vidler, director and general manager of W. T. Henley's Telegraph Works Co., Ltd. Mr. S. E. Goodall, the company's chief engineer, who presided at the subsequent proceedings, spoke of the advantages gained by students from the scheme, not only technical and social but in the way of developing leadership qualities.

After the presentation of awards to the year's prizewinners by Mr. Vidler, Mr. Goodall introduced the Rev. David Sheppard, a member of Sussex and England cricket teams, who gave an address.

This year's exhibition was a display of handicrafts and demonstrations by various youth organisations, the Woolwich Recreational Institute, the Gravesend School of Art and several commercial concerns. A section was devoted to the work of Henley students and prizes for exhibits in this section were presented by Mr. S. J. Wilson, general works manager, Gravesend. After tea there was a stage show.

The committee responsible for the organisation of the conversazione consisted of Messrs. G. O. Allerston, A. S. Brewer, F. Davis, H. C. Hoban, R. D. McAvoy, F. Ponder, W. J. H. Seager and D. J. Swadkin.

At the Henley Conversazione: Sergt.-Major E. J. Doury (leader of the Army Cadet Force contingent), the Rev. David Sheppard, Mr. S. E. Goodall and Mr. A. S. Brewer



A.P.L.E. SOUTH WESTERN SECTION

AT a meeting of the South Western Section of the Association of Public Lighting Engineers at Cheltenham on 9th November, Mr. Gould Marsland, M.B.E., B.Sc., presented a paper on "Development of Street Lighting in Cheltenham." He pointed out that some of the trial installations put into service in the town in 1936 on the occasion of the annual conference of A.P.L.E. were still in service. A town of the character of Cheltenham, with its many Regency buildings, called for care in the selection of equipment if amenities were to be preserved, and steel columns of an approved design were used, although the new housing estates on the outskirts were provided with concrete columns.

A second paper, on "Plastics in Public Lighting," was presented by Dr. W. E. Harper, who covered the selection and preparation of suitable plastics, the parameter imposed by working conditions resulting in only one type being of any value, that of the acrylic group, which was an outcome of development of a suitable material for aircraft canopies. Acrylics were not a substitute for glass but materials having quite different characteristics, and should not be expected to behave as unbreakable glass.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £280 5s 0d
Fire Refined 99·7%	ton £279 0s 0d
Fire Refined 99·50%	ton £278 0s 0d
COPPER Tubes ..	lb 2s 9½d
Sheet	ton £351 0s 0d
H.C. wire and strip ..	ton £315 0s 0d
LEAD, English ..	ton £120 0s 0d
Foreign	ton £119 0s 0d
MERCURY	flask £83 10s 0d
TIN, block (English) ..	ton £845 0s 0d
ZINC, G.O.B. Foreign	ton £100 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 3½d
Sheet	ton —
Wire	lb 2s 11½d
PHOSPHOR BRONZE Wire	lb 4s 4½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 32½d—32⅝d

INDIAN ELECTRICAL PROJECT

In New Delhi last Saturday Mr. Frank Tearle, a director of A.E.I., Ltd., delivered to the Indian Ministry of Production the detailed report on the establishment of an Indian heavy electrical plant factory. The report had been prepared by Associated Electrical Industries in its role as consultant to the Indian Government on this project.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Dr. A. M. Uttley has been appointed as superintendent of the Control Mechanisms and Electronics Division of the National Physical Laboratory in succession to Mr. R. H. Tizard, who has taken up an appointment at the London School of Economics.

The South Western Electricity Board at its last meeting accepted the resignation of its chief engineer, **Mr. G. O. McLean,** M.Eng., A.M.I.E.E., who has directed the Board's engineering activities since it was formed in 1948. He has served the electricity supply industry at home and abroad for thirty-three years, and is now to act as an engineering and industrial consultant in the South West.

Mr. G. O. McLean

Mr. McLean was educated at Liverpool University and received his practical training with the Manchester Corporation and Mather & Platt, Ltd. After a short period as assistant engineer at Lister Drive station, Liverpool, he went to Calcutta as station engineer and while there was hon. lecturer and external examiner in electrical engineering at Calcutta University. In 1933, on his return to this country, he became maintenance engineer at Sculcoates station, Hull, and in the following year was appointed personal assistant to the city electrical engineer. Three years later he took up the position of deputy borough electrical engineer at Ealing, and in 1940 took charge of the engineering section of a Dutch firm exporting to the Dutch East Indies. From 1945 to 1948 he was with Edmundsons Electricity Corporation (in the latter part of that period as personal assistant to the managing director).

Mr. McLean is the author of "Steam Power Stations" and has contributed a number of articles to the *Electrical Review*. He has taken considerable interest in the construction of heat pumps, and two which he built himself in 1951 are still in use in Bristol.

At the recent annual dinner of the Tees-Side Sub-Centre of the **Institution of Electrical Engineers,** at Saltburn (Yorks.), Mr. G. S. C. Lucas (a vice-president of the Institution) referred to the subject of technical education in Britain. He said that a British delegation had recently visited Russia, and although Britain was ahead of Russia in many things, Russia was ahead in the recruitment and training of young men in engineering. If Britain could apply the same methods, this country would again forge ahead of Russia. Mr. G. Cowan, borough engineer, Stockton-on-Tees, proposed the toast of "The Institution." The dinner was presided over by Mr. F. W. Allan (Sub-Centre chairman).

The Metropolitan-Vickers Electrical Export Co., Ltd., has recently appointed **Mr. H. F. Bibby,** B.Sc.Tech., A.M.I.E.E., A.M.I.Mech.E., formerly manager, American Division, as assistant general manager. He has been succeeded as manager, American Division, by **Mr. C. H. de Nordwall,** M.I.E.E., who retains his seat on the board of Metrovick do Brasil (Eletricidade), Ltda.

Mr. Bibby joined the Metropolitan-Vickers Co. in 1929 for the first year of a probationary college apprenticeship course, returning to complete the course four years later and then joining the staff of the Motor Engineering Department. In 1939 he transferred to the M-V Export Co. and went to the Hague as liaison engineer with the company's former agents in Holland, from which country he escaped to England with his wife three days after the German invasion of May, 1940. During the war he was engaged on development work in the Motor Engineering Department. In 1945 Mr. Bibby rejoined the Export Co. and in the following year returned to Holland as manager of the company's new office at the Hague. During 1951 he spent several months in South America, and he was subsequently appointed manager, American Division, of the Export Co. in London.

Mr. de Nordwall received his technical education at Faraday House and joined Metropolitan-Vickers as a college apprentice in 1922. After a period in Nigeria as chief engineer of North Nigeria (Banchi) Tin Mines, Ltd., he went to Russia in 1930 with M-V erection staff. Three years later he transferred to the company's London office. In 1938 he joined the British Electrical Development Association as power development engineer. From 1939 to 1945 he served in various parts of Europe with the Royal Engineers, attaining the rank of colonel, and afterwards became director, Electrical Industries Branch, of the Control Commission in Germany. In 1947 he returned to Trafford Park, joining the sales management staff, and in the following January he was appointed sales manager, Industrial Control Department. In 1953 he transferred to the Export Co. and was appointed manager for South America.

Mr. H. F. Bibby

Mr. C. H. de Nordwall

Mr. H. Scholes, Grad.I.Prod.E., new products engineer/project engineer, of Joseph Lucas Electrical, Ltd., has been awarded the Schofield Travel Scholarship for 1956 by the Council of the Institution of Production Engineers.

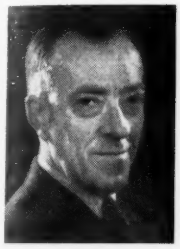
In our issue of 19th October we reported the appointments of senior officers of the Southern Region, British Transport Commission, to assist Mr. W. J. A. Sykes, who recently became chief mechanical and electrical engineer in charge of the carriage, wagon, mechanical and electrical department. **Mr. H. S. Smyth,** B.A.(Cantab.), A.M.I.E.E., who has been appointed electrical engineer, was educated at Cheltenham College and Queens' College, Cambridge, where he obtained an honours degree in mechanical sciences. Subsequently he served a three-year student apprenticeship with the British Thomson-Houston Co., Ltd., at Rugby. In 1927 he was appointed to the staff of the electrical department of the Buenos Ayres Western Railway, eventually occupying the post in 1937 of electric and diesel rolling stock superintendent under the chief electrical engineer until the sale in 1948 of the British-owned railways in Argentina. In December, 1948, he joined the staff of the electrical engineer, Southern Region, British Railways, being appointed general assistant (electrical) in 1950 to the then mechanical and electrical engineer.

Mr. H. S. Smyth

Mr. W. S. Ramsdale, M.I.E.E., is to retire from the post of head of the construction section of the Chief Engineer's Department, North Eastern Electricity Board, on 31st December.

Mr. Ramsdale entered the electricity supply industry as a premium pupil with the Whitby U.D.C. Electricity

Department in 1913. After serving with the Royal Engineers during the 1914-18 war he joined the Cleveland & Durham Electric Power Co. as a junior engineer. He subsequently held various appointments with this company and its successor, the North Eastern Electric Supply Co., Ltd., both on Tyneside and Tees-Side, and in 1947 was appointed engineer in charge of the Electrical Construction Department. At vesting date he was appointed to the post he now vacates. Mr. Ramsdale has served on a number of B.S.I. and other national committees and is a past chairman of the Tees-Side Sub-Centre of the Institution of Electrical Engineers.



Mr. W. S. Ramsdale

Mr. E. J. Grubb

Mr. E. J. Grubb, B.Sc., M.I.E.E., who will succeed Mr. Ramsdale as head of the construction section of the Chief Engineer's Department, with effect from 1st January, received his technical education at Bristol University and in 1923 joined the North Eastern Electric Supply Co., Ltd., as a student engineer. After holding various appointments with this company, he was transferred in 1941 to its southern area at Middlesbrough as chief assistant engineer in the Construction Department. He occupied this post for six years and was then appointed to a similar position at Newcastle-upon-Tyne. He took up his present position as sub-area engineer, Tees Sub-Area, at vesting date. Mr. Grubb is a past chairman of the Tees-Side Sub-Centre of the Institution of Electrical Engineers.

Mr. Frank F. Newlands, a director of Claude-General Neon Lights, Ltd., has completed twenty-one years' service with the company.

Two further sales engineers have been appointed recently by Brook Motors, Ltd., one to their Bristol office and the other to London. **Mr. C. T. Hinchliffe,** who is at Bristol, has had nine years' service with the company and studied at the Barnsley Technical College. A Brook apprentice, he spent some time in the Research Department at the Huddersfield works and with the Huddersfield sales office, and also had two years' Army service on electrical control equipment. **Mr. W. B. Knowles,** Graduate I.E.E., now at the London office, has ten years' service with Brook Motors. He was educated at Barnsley Grammar School and Technical College, and is also a former apprentice. Before his appointment to London he spent some time at the Sheffield office.

Dr. C. W. R. Pyne, M.B., Ch.B., D.P.H., has been appointed assistant medical officer with the Metropolitan-Vickers Electrical Co., Ltd.

Mr. P. E. Pike has been appointed branch manager of Alliance Wholesale, Ltd., 62-63, Great Russell Street, London, W.C.1. He succeeds **Mr. P. Beale,** who is now in charge of the company's new tool store and trade counter at 64-66, Newington Causeway, London, S.E.1.

Mr. J. Samuels, who joined Winston Electronics, Ltd., in 1954, has now been elected to the board of the company.

Mr. S. Roberts, managing director of Hoover, Ltd., left by air on 17th November for a visit to Australia and New Zealand.

Mr. J. Entwistle, B.Comm., of Cheadle Hulme, Cheshire, principal assistant (superannuation, wages and organisation) in the Chief Accountant's Department at the Manchester headquarters of the North Western Electricity Board, has been appointed sub-area accountant of the Board's No. 5 Sub-Area based on Blackburn. He succeeds **Mr. N. J. Haddon,** who is retiring.

Mr. H. Hampson, reader in mechanical engineering at Queen Mary College, London, who was formerly on the staff of the Metropolitan-Vickers Electrical Co., Ltd., has been appointed reader in applied thermodynamics at Aberdeen University and head of the Department of Mechanical Engineering at Robert Jordan's Technical College, Aberdeen, and will take up his new duties next April.

On 25th October nearly 200 members of the staff of British Insulated Callender's Construction Co., Ltd., assembled in London to pay tribute to **Mr. C. O. Boyse** who, as we have previously reported, has relinquished his duties as director and general manager to join the management of the Automatic Telephone & Electric Co., Ltd. Mr. G. H. Walton, a director and joint general manager of the Construction Co., presented Mr. Boyse, on behalf of the staff, with a set of Encyclopædia Britannica and a handsome cocktail cabinet.

Mr. A. R. Wassell, formerly with the Mersey Cable Works, Ltd., has joined Permanoid, Ltd., as northern sales manager. Mr. Wassell, who is a member of the committee of the North West Branch of the Association of Mining Electrical and Mechanical Engineers, will be based at the head office and works in Manchester.

Mr. R. E. Baird, who has represented M.K. Electric, Ltd., in Northern Ireland for the last eight years, will cease to do so by mutual consent as from 1st December. In expressing their appreciation of Mr. Baird's work for them the company say that they intend to appoint a member of their own staff to cover this area.

The Metropolitan-Vickers Electrical Co., Ltd., announces that **Mr. J. L. Mease,** B.Eng., A. M. I. Mech. E., A. M. I. Prod. E., has been appointed as an additional assistant superintendent at the Sheffield Works. Mr. Mease was a special apprentice at Cammell Lairds and after taking his degree at Sheffield University went to the Metropolitan-Vickers Co. as a college apprentice in 1932. On completing his course he joined the engineering staff of the company's Sheffield works as a junior process engineer. After periods as motion study engineer, assistant to the works superintendent (on cutting tools development), and production engi-

Mr. J. L. Mease

Mr. G. H. Walton making a presentation to Mr. C. O. Boyse who recently left B.I. Callender's Construction Co. to join the Automatic Telephone & Electric Co.

neer, he was appointed head of the Production Department in 1941, and he will continue to exercise this function in his new post. **Mr. R. S. Hinds,** who has been assistant superintendent at Sheffield since October, 1949, will continue as at present to be concerned with manufacturing operations.

At the annual meeting of the **Electrical Trades' Commercial Travellers' Association** held on 16th November the following officers were installed:—President, Mr. W. J. Jones, M.Sc.(Eng.), M.I.E.E.; chairman, Mr. F. J. E. Simons; hon. general secretary, Mr. W. J. Clewes-Garner; hon. treasurer, Mr. R. T. Yates; hon. subscription secretary, Mr. G. K. Heffernan; hon. charity steward, Mr. S. Johnson; hon. Press steward, Mr. E. R. Stickley; hon. employment secretary, Mr. C. F. Saunders; and hon. social secretary, Mr. A. J. Murray.

Mr. Jones is well known as director of the Electric Lamp Manufacturers'

Mr. W. J. Jones

Mr. F. J. E. Simons

Association and for his activities on national and international committees on lamps and illumination.

Mr. Simons joined Siemens Electric Lamps & Supplies, Ltd., in 1946. He has been a member of the Association for nine years and was hon. employment secretary in 1952. During the last war he served with the R.A.F.

At the meeting it was decided to contribute £400 to the Electrical Industries Benevolent Association and £100 to the Royal Commercial Travellers' School, and Mr. D. G. E. Barrie (vice-president) added £100 to the E.I.B.A. and £25 to the R.C.T. School.

Mr. F. P. Hahn, M.Eng., A.M.I.Mech.E., A.M.I.E.E., who in this issue (page 951) deals with inert gas arc welding equipment for aluminium, took a first class honours degree at Liverpool University in 1942. He joined the Metropolitan - Vickers Electrical Co., Ltd., as a college apprentice in the following year, and then entered the Welding Engineering Department, where he has since been engaged on the design and development of welding equipment.

Mr. F. P. Hahn

At the invitation of the directors about 100 members of the staff and guests of **Greenwood's & Airvac Ventilating Co., Ltd.,** and associated companies, Rhodes Chains, Ltd., and Greenwood & Hughes, Ltd., attended a dinner at the Washington Hotel, Mayfair, on Wednesday, 14th November. Mr. B. Donald Hughes (managing director) presided.

Following the loyal toast and that of "The Staff," proposed by the chairman, presentations were made by Mrs. Hughes to a number of members of the staff in recognition of their long service to the company. An excellent cabaret followed by dancing rounded off a successful social evening.

An association of Ransomes and Rapier student apprentices was formed at a recent meeting held at Waterside Works, Ipswich. Mr. J. G. MacLachlan, director, presided at the meeting which was attended by Mr. N. F. Dare, works director, Mr. F. Clifton, works manager, Mr. E. Sparrow, personnel manager, Mr. R. G. Gross and forty student apprentices. The association, to be known as the **Rapier Student Apprentices Association,** has been formed to promote discussion and interchange of ideas between student apprentices and to arrange tours of inspection of other works and installations of technical interest to mechanical, electrical, structural and production engineers.

Proposing the toast of the **Exeter Electric Club** at its annual dinner in Exeter on 16th November, Mr. A. N. Irens, chairman of the South Western Electricity Board, referred to the good relations existing between private and public enterprise in the electrical industry in the South West—between electrical contractors, wholesalers, manufacturers and the South Western Electricity Board. He said that great responsibility rested upon all branches of the industry to ensure success in developing nuclear energy to lighten the burden of work in Britain's homes, factories and farms. Capital charges would form about two-thirds of the cost of nuclear generation, and it would be all the more important to ensure that this capital equipment was used to the fullest extent.

OBITUARY

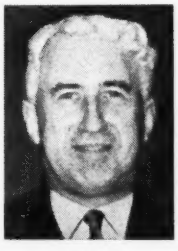
Mr. W. J. Norrie, who died on 4th November at the age of fifty-four, was divisional repairs and maintenance engineer with the North West, Merseyside and North Wales Division of the Central Electricity Authority. Born and educated in Liverpool, he served an apprenticeship with Fawcett Preston & Co., and subsequently joined the Liverpool Corporation Electricity Supply Department, serving at both the Lister Drive and Clarence Dock power stations. In 1944 he was appointed mechanical maintenance engineer at the Tir John power station of the Swansea Corporation and on nationalisation returned to Liverpool as mechanical maintenance engineer of the newly formed Merseyside and North Wales Division. The amalgamation of the North Western and Merseyside Divisions led to his appointment in the capacity in which he served until his death.

Mr. J. A. Taylor, A.M.I.C.E., A.M.I.E.E., who retired from the staff of the Pritchett & Gold and E.P.S. Co., Ltd., three years ago, died on 28th October at the age of sixty-nine. Mr. Taylor was educated at Faraday House and gained his early practical experience with Bruce Peebles & Co., Ltd. Before joining Pritchett & Gold in 1919 he had charge of fuze production at five National Ordnance Factories in Leeds from 1916 to 1918. He was mainly concerned with the export business of Pritchett & Gold, for whom he travelled extensively.

The late Mr. J. A. Taylor

Mr. Williams Laws, M.Sc., M.I.E.E., whose death occurred on 11th November at the age of sixty-five, was formerly principal of Poplar Technical College. He was in the a.c. machine design department of Siemens Bros. Dynamo Works before the 1914-18 war, and after war service was with the English Electric Co., Ltd., for eight years. He took up teaching in 1928 as head of the Electrical Engineering and Physics Department of Rochdale Technical College, and in 1930 went to Poplar as associate head and head of the Electrical Engineering Department of the L.C.C. School of Engineering and Navigation (now Poplar Technical College). He ultimately became principal of the College, retiring in 1953.

Mr. E. J. Riordan, B.E., A.R.C.Sc.I., M.I.E.E., chief engineer of Aron Electricity Meter, Ltd., died on 14th November at the age of fifty-three. Mr. Riordan, who was educated at the Royal College of Science and University College, Dublin, served for three years as test and research engineer in the Meter Department of Ferranti, Ltd., before joining Aron Electricity Meter, Ltd., in 1928 as meter engineer. He was the inventor of many electromechanical mechanisms and during his long term of office with the Aron Co. was responsible for the design and development of many of its products,



The late Mr. E. J. Riordan

Special Induction Motors

Unusual Designs Described in Two I.E.E. Papers

TWO papers emanating from Manchester University on unorthodox designs of induction motors were presented on 15th November before the Institution of Electrical Engineers' Utilisation Section. The first, by Messrs. E. R. Laithwaite and P. J. Lawrenson, described a self-oscillating motor for propelling a shuttle across a loom. The principle adopted is that of a linear machine having a conventional stator cut open along one side and unrolled, producing a travelling instead of a rotating magnetic field. An electrical conductor within this field would be accelerated towards the speed of the field (twice the product of the pole pitch and frequency of stator supply).

The purpose is to secure three advantages over normal practice, viz. continuous acceleration and deceleration of the shuttle over its entire travel, thus minimising accelerations; reduction of wear of parts; avoidance of damage should the shuttle fail to enter the shed, since in the electrical design it is at its slowest at the start of the travel.

The stator windings are in two halves, each producing a travelling field directed towards the centre of the stator. Oscillation with stable amplitude requires a leakage-reactance/resistance ratio that would produce a maximum force at a speed greater than zero. Each successive run produces a rest position further from the centre until the rotor attains nearly synchronous speed, beyond which no further increase in amplitude can result. The characteristic of the load against which the shuttle operates is almost certainly non-linear, but it is shown that a stable cycle of operations can be achieved. A practical scheme is worked out that appears to indicate ability to meet the requirements of weaving technique.

In the other paper Professor F. C. Williams and Messrs. E. R. Laithwaite and L. S. Piggot describe an experimental brushless variable-speed motor. The present study extends an investigation reported in the I.E.E. *Proceedings* of November, 1954, wherein the correctness of the theoretical approach was demonstrated by a disc machine, which, however, had too low an efficiency to be of use. The authors now describe a machine having a spherical-barrel rotor of 14in diameter, giving a speed range up to 5·5 : 1, which depends markedly on the ratio of pole width to pole pitch. They show that its losses cannot be accounted for by conventional theory and that the extra losses are due not to the variable-speed characteristics but to the stator being " short " and not continuous round the machine. The main practical difficulty is that with this type of machine, being essentially multipolar, the pole pitch tends to be small with attendant difficulties as regards leakage inductance, excessive copper loss and high magnetising current. It appears that efficient machines can be made only with rotor diameters of at least 24in to give a speed range of 2 or 3 to 1 at 50 c/s. Acknowledgments of help are made to the Metropolitan-Vickers Electrical Co. in making the experimental machines and to Mr. A. Gledson in regard to their mechanical design and construction.

DISCUSSION

Opening the discussion, Professor G. H. Rawcliffe (Bristol University) said that the authors had shown that everything in power engineering had most emphatically not already been done. Professor Williams had criticised himself for getting an efficiency of only 44 per cent but a widely-used sewing machine motor had an efficiency of only about 17 per cent.

Mr. E. M. Briscoe (Crompton Parkinson) expressed disappointment that more information had not been given about the variable-speed motor on 50 c/s operation. For experimental purposes the use of high frequencies was necessary, but this made it more difficult to assess the potentialities of the machine. Not only was a variable speed needed but also ability to control the torque output of the machine at different speeds, implying some form of feedback to keep the characteristics desired. In that case a Ward-Leonard system with some sort of electronics would be of great assistance.

Mr. W. Hill (Metropolitan-Vickers) pointed out that many motor applications did not call for rotation; what was wanted in most cases was translation. In using a lift, for example, one expected to go up or down and not round and round, and a big step forward had been taken in aircraft when the jet engine replaced the propeller. The demonstration of linear motion by Messrs. Laithwaite and Lawrenson might be to industry what the jet engine had been to air transport. Some form of linear accelerator might be used to move trains (without the need of overhead lines) by being placed at intervals to give the train a push. It need not be energised all the time as the approach of the train could energise the coils.

Mr. R. L. Russell (University of Bristol) described the use at Bristol of two balanced polyphase supplies connected simultaneously to three coils to form an orthodox three-phase stator winding. The resulting magnetomotive force varied sinusoidally with time at a frequency equal to half the sum of the applied frequencies about an axis which rotated at a frequency equal to half the difference. A salient pole rotor would behave as an electric differential and would cause a shuttle to move slowly to the left or right depending on the sign of the frequency difference between the two systems, or, if the frequencies were the same, it would be held in one position. Ability to position a moving element linearly simply by altering the setting of a phase shifter might have some applications.

Mr. F. Najmabadi (Metropolitan-Vickers) compared the authors' variable speed spherical motor with other variable speed machines. The Schrage motor, he said, appeared to have a better power factor at top speed and probably at the synchronous speed setting, but at bottom speed there was not much difference between them. Percentage efficiencies at top speed were: Schrage motor 79, Ward-Leonard 65, a.c. commutator motor 79, and the authors' spherical motor 75. The weight/power ratio was 55 lb/h.p. for the ordinary squirrel-cage induction motor, 114 for the Schrage, 125 for the Ward-Leonard, 140 for the a.c. commutator motor with regulator, and 95 for the authors' motor. Taking the cost of the normal squirrel-cage induction motor as 100, the figures would be: for the Schrage, 380; for the Ward-Leonard, 400; for the a.c. commutator motor, 450; and for the authors' motor roughly 260.

Mr. R. D. Ball (E.E.C.) said that the authors used a discontinuous stator instead of the usual ring stator, resulting in various end effects when the magnetic circuit was broken. With a ring stator the rotor was conditioned continuously into the right phase, but with the discontinuous stator an unconditioned rotor had to slip a pole before it did any work.

Mr. B. Adkins said he once held it impossible to devise an electric motor with a continuously variable speed unless it had a commutator. He had examined various proposals which purported to do this, but they had always been based on a fallacy. The authors, however, had now done this impossible thing.

BRITISH NUCLEAR ENERGY CONFERENCE SYMPOSIUM

Yesterday (Thursday) a two-day symposium of nineteen papers covering the planning, design and construction of the Calder Works nuclear power plant, which has been organised by the British Nuclear Energy Conference, was opened at the Central Hall, Westminster.

Calder Works Plant

Following an introductory lecture by Sir John Cockcroft nine papers on the general design of the station and technical research problems were presented (see "Electrical Review," 16th November, pp. 909–912). To-day's papers, which are summarised in the following pages, cover engineering design and future developments. The discussion will be reported next week.

ENGINEERING design is the general subject considered at the meeting of the British Nuclear Energy Conference which is being held at the Central Hall, Westminster, to-day (Friday). The chairman is Mr. W. L. Owen and the first group of three papers, which are being introduced by Sir Claude Gibb, will be jointly discussed.

In the first paper, by Messrs. G. Brown, M. J. Noone and R. F. Bishop, a description is given of the reactor pressure vessel at Calder Hall. This is 37ft in diameter by 70ft overall height at the shell and is of fusion-welded construction from 2in plate. The normal working pressure is 100 lb/sq in and the maximum design temperature for the shell 752 deg F. The normal inlet and outlet temperatures of the carbon dioxide are 284 deg F and 644 deg F.

Material Properties

The material used, the authors say, must be corrosion-resistant to carbon dioxide, have good creep properties up to 752 deg F and yet be as free as possible from the danger of brittle fracture during site fabrication. After stainless and stainless clad steels had been considered a low carbon "Lowtem" mild steel was chosen. This is supplied in the normalised condition and is superior to ordinary mild steel on Charpy impact test. A shell thickness of 2in was chosen as vessel designers had had considerable experience in welding steel similar to "Lowtem" up to this thickness and a design stress of 12,000 lb/sq in at the design temperature of 752 deg F with a joint factor of 0·95 was selected. This necessitated full X-ray examination of all the butt welds and stress relief of the finished vessel. Two long creep tests using a stress of 11,200 lb/sq in at 716 deg F showed that after 15,000 hours the creep rate was still decreasing, the total creep strain at 100,000 hours being estimated at 0·18 per cent.

To minimise the creep effects arising from the heat produced in the vessel walls by the absorption of the gamma rays, which result from the capture of neutrons leaving the graphite reflector, the side walls of the shell were cooled internally by bleeding about 0·5 per cent of the total flow of carbon dioxide through the seal between the graphite and the vessel. The top dome is "cooled" internally by carbon dioxide and externally by air.

Constructional Details

As regards design, the vessel consists of five strakes and top and bottom domes of semi-ellipsoidal form. With a stress of 13,750 lb/sq in the theoretical thickness is 1·63in and the excess thickness for reinforcement 0·37in. The vessel is designed to withstand a full vacuum. The graphite moderator and associated equipment, weighing a total of some 1,400 tons, are supported on a rectangular grid framework, as shown in Fig. 1, the ends of which terminate on a circular ring girder. The grid itself is supported on 20 brackets equally spaced around the vessel and welded to cheek plates which in turn are welded to the bottom dome. It is maintained concentric with the shell by four radial keyways. The load of the moderator is transmitted directly through the vessel wall to external brackets, which are welded to corresponding cheek plates directly opposite the inner brackets. These external brackets are seated on the rolling surfaces of 10 columns in the form of inverted A frames with ends machined to form part of a cylinder of diameter equal to the column height. The bases of these columns roll on flat plates which are mounted on grillages resting on the concrete foundations.

Pressure Vessel

The pressure vessel was fabricated on site, construction being carried out in five sections. A possible alternative would have been to build the vessel *in situ* piece by piece. This would, however, have meant a delay of more than six months. Details are given in the paper of the actual methods of erection used, including the assembling and fixing of the charge tubes of the thermal insulation. An electrical method of stress relief was adopted, as it was more easily controlled and was cleaner and simpler. For this purpose two radiant electric heaters, consisting of stainless steel tubes, were arranged in vertical lengths round the side of the shell. The dimensions of the tubing were arranged to give a maximum surface temperature of 1,472 deg F. The electrical input to the system was 1·5 MW. Full details of the installation arrangements are given in the paper as well as an account of the pressure and vacuum tests applied to the vessel.

Uranium Fuel Handling

In a second paper, Messrs. K. H. Dent and G. W. Grossmith deal with the problem of charging a gas-cooled reactor. The possibility of recharging the Calder reactor at pressure using valve gear and the pressurised airlock principle was considered, but was thought to be too complicated at that stage of development. The principle was therefore adopted of shutting down and depressurising the reactor to discharge large quantities of metal at infrequent intervals rather than to recharge continuously with the reactor at power.

No mechanism or moving parts are built into the reactor core or other places subject to radiation. The equipment is kept either external to the reactor or is inserted into it during use only. During recharging the coolant is maintained at about 300 deg F at the outlet end of the reactor. This facilitated the design and operation of the charging gear without unduly increasing the range of thermal cycling of the fuel and plant. At this tempera-

ture the differential expansions in the system are reduced to easily manageable proportions.

Recharging Arrangements

To allow access to the channels for recharging, flanged openings in the vessel are provided. The branches for this purpose are extended vertically through the top of the biological shield and each is arranged to serve a group of 16 fuel channels in the graphite. Access to each channel in turn is gained by a charge chute. During the recharging operation the carbon dioxide pressure is maintained at about 2in water gauge above atmospheric pressure, so that the charge chute can be introduced into the pressure vessel through rubber glands. This gives temporary sealing without the need for high-pressure gas locks.

The general procedure for discharging is therefore to shut down the reactor by motoring-in the control rods, limiting the rate of change of temperature to less than 2 deg C per min and then, when the gas temperature is sufficiently reduced, to blow down the vessel and one or more external gas circuits.

During the refuelling operation the coolant pressure is maintained slightly above that of the atmosphere and its outlet temperature is controlled at a steady reduced value. When the operation is complete the pressure is raised by the introduction of fresh carbon dioxide and the control rods are slowly withdrawn to bring the reactor back to power. Details of the fuel handling cycle and of the charge and discharge plant, which is electrically driven, are also given in the paper.

The third paper to be considered in this group is on the design of important plant items and is being presented by Messrs. A. T. Bowden and G. H. Martin. In general, the turbo-generator plant is of orthodox design. The full heat output from the reactor must, however, be consumed at all times so that the turbines are therefore normally operated under steam pressure control. If the reactor heat output exceeds that which can be absorbed by the turbines the surplus steam automatically passes to a dump condenser and is returned as water to the feed system.

Steam is supplied from the heat exchangers to two Parsons turbines, each of which absorbs 198,000 lb/hr at 185 lb/sq in and 590 deg F. The exchangers also deliver an additional 59,300 lb at 38 lb/sq in and 340 deg F. The steam is condensed in a surface condenser at a vacuum of 28·25in. To maintain the pressure substantially constant at 185 lb/sq in, the high-pressure governor valve is provided with a steam pressure controller, operated by the pressure in the steam receiver, in addition to the usual speed controller. The low-pressure system is regulated by a control valve with pressure-actuated controller and provides a means of maintaining the inlet gas temperature to the reactor reasonably constant at all outputs.

Each of the steam dump condensers is capable of taking the whole of the steam from two fully loaded turbo-generators. The steam isolating valves on this equipment are electrically interlocked with the circulating water valves so as to maintain the steam valve motors in a de-energised state until the interlock closes, when about 25 per cent of the circulating water is passing through the tubes. Vertical dead weight relief valves are fitted to the dump steam mains and begin to open when the pressure reaches 10 lb/sq in. If a machine trips, the dump valves will begin to open when the pressures reach 195 lb and 40 lb/sq in. Every attempt has been made to ensure stability of operation in spite of the flexibility obtained by using dump condensers.

Gas Circulators

After full consideration had been given to alternative forms of drive for the main gas circulators it was decided to use a motor-generator supplying d.c. to motors operating on the Ward-Leonard system. This type of drive was chosen because it was reliable and stable at all speeds, it allowed the speed range of 10 : 1, considered necessary for starting and control purposes, to be

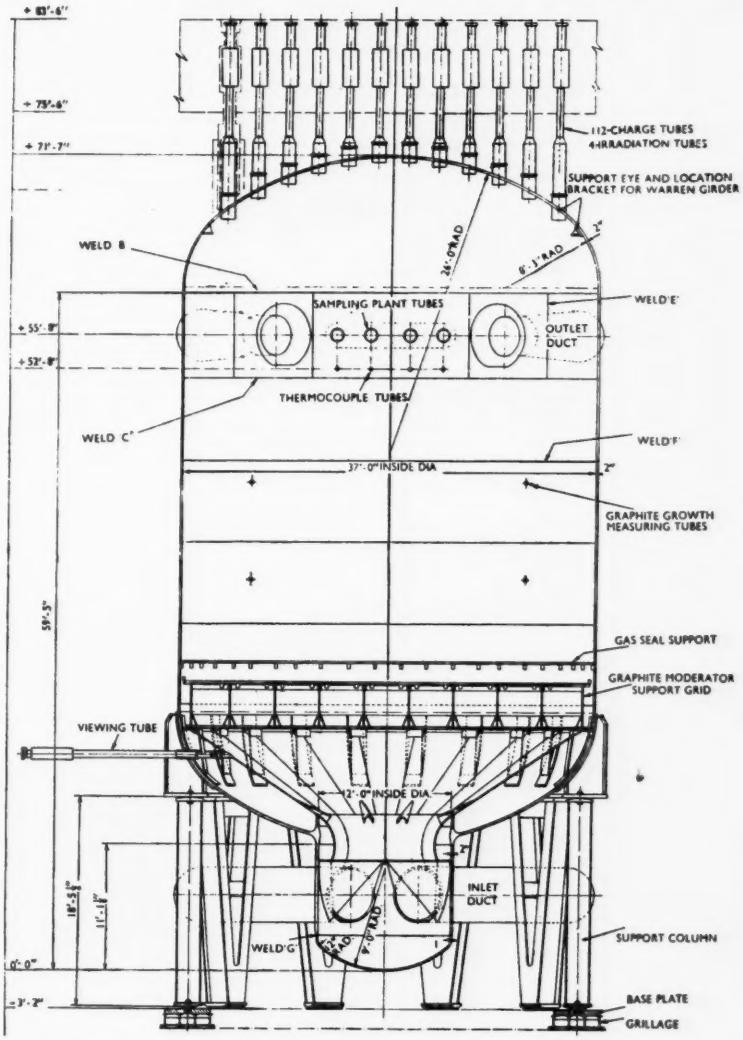


Fig. 1.—General arrangement of reactor pressure vessel: elevation (Brown, Noone and Bishop)

obtained, and it would give a positive and stable response without hunting if automatic thermostatic control of the circulator speed were introduced later. The decision to employ this system demanded a circulator of the centrifugal type owing to the speed limitations of d.c. machines of large output.

The mass flow of carbon dioxide through the reactor in normal conditions is 1,964 lb/sec at 100 lb/sq in and 284 deg F at the circulator outlet. This duty is shared by four circulators and, as a bleed of about 2 per cent is taken off continuously for filtration and drying purposes and returned to the circuit at the circulator inlet, each is designed for a mass flow of 500 lb/sec. In addition, to cater for the departure of the actual from the theoretical values of circuit pressure drop and mass flow and to give a degree of flexibility to the design the maximum duty is specified at 550 lb/sec.

Characteristic curves showing the designed performance of the circulator at various speeds are given in Fig. 2 (a) together with the measured performance based on works tests carried out with air and corrected to carbon dioxide. Corresponding estimated and measured efficiency curves are given in Fig. 2 (b). The deflections which occur under the specified operating conditions made the fitting of through stay bolts desirable and necessitated making the shape and dimensions of the diffuser vanes different from those theoretically desirable. Again, with emphasis on efficiency, a full volute design was considered necessary, while to reduce the stress and deflection on the casing under operating and water test conditions it was decided to offset the volute. To keep the gas leakage down to the minimum consistent with reliable operation an overhung design was selected and after preliminary experiments oil seals of the type used in hydrogen-cooled generators, but modified to cater for the higher pressures and temperatures involved, were selected.

Details are given in the paper of the lubrication and seal-oil systems. In each case there are two sets of full duty pumps which run continuously, one of which is driven by an a.c. and the other by a d.c. motor. The main circulator drives and the methods of remotely controlling them are also described.

Gas Duct Problems

The principal problems associated with the 4ft 6in gas ducts used were those concerned with maintaining a leak-tight system and ensuring sufficient flexibility so that, in spite of the considerable differentials involved, the loads on and movements in the reactor vessel, heat exchangers and circulators to which they are connected were kept to very low limits. At the same time the pressure drop in the system had to be kept to the minimum. The general design was based on the roughly comparable conditions in large gas turbine installations. The bellows units and flanges employed are described in the paper and the design conditions essential to secure the necessary flexibility are set out.

Steam-Cycle Analysis

The three papers of which an account has been given above are being discussed together. There are two further papers by Mr. R. E. Zoller, one on "Steam-Cycle Analysis" by Mr. W. R. Wootton and the other on "Design and Construction of Heat Exchangers" by Messrs. H. Morris and W. R. Wootton. In the first of these it is pointed out that the thermal outputs of the Calder Hall reactor range from 100 to 250 MW and that the coolant temperatures, flows and pressure losses all satisfy the requirement of a constant maximum fuel element surface temperature of 752 deg F. At the lowest thermal output, 100 MW, the highest coolant temperatures leaving the reactor are attained and the pressure loss is least. The corresponding steam-cycle thermal efficiencies would be the highest not only because of the higher temperature, but because the power consumed by the coolant circulators is least. On the other hand, at the highest thermal output, 250 MW, the lowest coolant temperatures leaving the reactor prevail and the draught loss is highest. The corresponding steam-cycle thermal efficiencies would be least; nevertheless, the net electrical output would be considerably higher than in the case of the reactor operating at a thermal output of only 100 MW.

Capital Costs and Efficiency

Since the capital cost of a given reactor is substantially constant, the higher electrical outputs would be associated with the lowest capital costs per net kW installed. On the other hand, the higher thermal outputs would be associated with higher plutonium production, although the fuel consumption would be higher owing to the lower steam-cycle efficiency. With conventional steam power plant, an increase in capital costs per kW installed can be justified if the gain in efficiency is sufficient because the fuel cost is the greater fraction of the total cost of generation. With nuclear power plant the reverse is the case, the effect of efficiency on the total cost of generation being less.

These major considerations influenced the steam-cycle analyses. They involved the investigation of optimum temperature differences in the steam raising plant, the employment of feed heating and reheating and the use of single, dual and triple pressure steam cycles. Such matters are discussed in detail in the paper and many

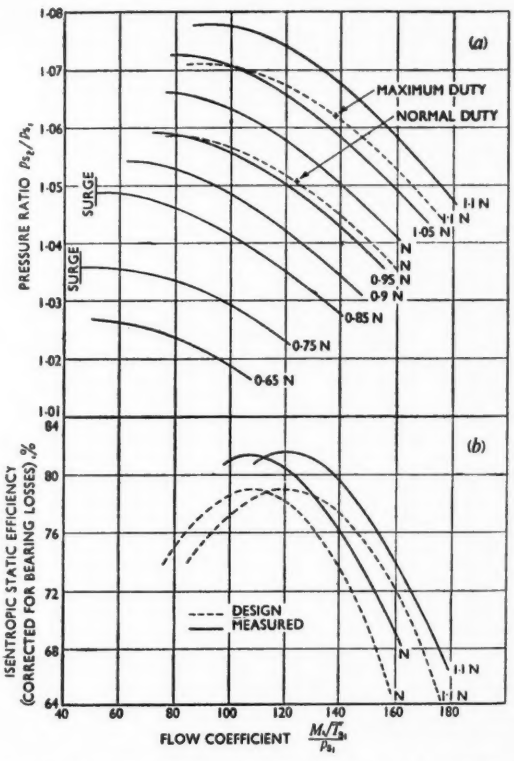


Fig. 2.—(a) Characteristic and (b) efficiency curves for main CO_2 circulators showing comparison of design and measured performance; p_{s1}=Inlet static pressure, lb/in²abs. p_{s2}=Outlet static pressure, lb/in²abs. M=Mass flow, lb/sec. T_{s1}=Inlet static temperature, deg F abs. (Bowden and Martin)

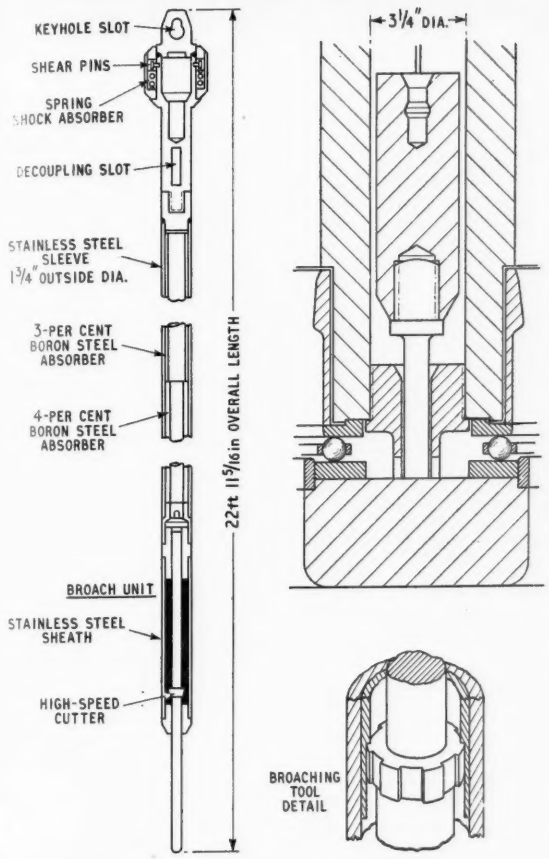


Fig. 3.—Arrangement of control rod and impact stool

interesting and sometimes unexpected features are revealed. The steam-cycle conditions adopted at Calder Hall may not be the best from a purely theoretical standpoint, but are very close to the optimum when the many over-riding practical considerations are taken into account. In future development, many of these practical issues will be resolved and the way will be opened for greatly improved steam-cycle conditions. The multiple-pressure steam cycle is sensitive to the outlet temperature of the reactor coolant and modest improvements in the latter will bring a rapid increase in efficiency. In the foreseeable future its application promises to be competitive on economic grounds with any other cycle, however high the permissible fuel temperature may be raised through metallurgical and technological advancement.

Heat Exchanger Design

In their paper on the " Design and Construction of Heat Exchangers " Messrs. H. Morris and W. R. Wootton state that at full load the flow rate of the carbon dioxide at Calder Hall is 491 lb/sec, the gas temperatures at the inlet and outlet being 637 deg F and 275 deg F respectively. The flow rate of high-pressure steam, which represents 77 per cent of the total, is 99,000 lb/hr at a pressure of 210 lb/sq in absolute and a temperature of 595 deg F. The flow rate of low-pressure steam is 29,650 lb/hr at a pressure of 62·7 lb/sq in absolute and a temperature of 350 deg F.

Each exchanger is supported on a skirt welded to the vessel itself and the whole assembly is mounted vertically on a reinforced concrete plinth to which the skirt of the vessel is bolted. The underside of the plinth is used to accommodate circulating pumps and ancillary gear. Gas from the reactor enters the heat exchanger vessel through a 6ft diameter opening at the top and passes over the tube system in cross flow, leaving the bottom of the shell for the circulators. The high-pressure and low-pressure tube systems, each consisting of superheater, evaporator and economiser sections, are contained within the heat exchanger shell. This shell forms part of the gas coolant circuit and operates at 100 lb/sq in. The steam drums and headers are mounted externally on the shell. All the interconnections between the various parts are also outside the vessel, the tubes being passed through thermal sleeves.

Heat Transfer Economics

To provide the necessary heat transfer surface economically the use of extended surfaces was essential and it was decided to use elliptical studs electrically welded to the tubes. Because of its size the shell had to be transported from the manufacturers' works in ten pieces, which were welded together on site. The shell was fabricated of " Coltuf 28 " steel which has an ultimate tensile strength of 28 to 32 tons/sq in with a yield strength of 17 tons/sq in and an elongation of 25 per cent on 8in. The main requirements for this material were good weldability and freedom from folds, laminations and cold cracking. The plates were all supplied in a normalised condition. Owing to the complex arrangements of the sections and internal tube work the manufacturing procedure was carefully organised as will be gathered from the information set out in the paper.

The longitudinal seams of the two half-plates forming each course were preheated to 100 deg F and adjoining courses were end-matched with each other. All the supporting brackets for the drums, headers and internal structures were fitted in place at this stage. The preparation for seams to be welded on site was of the deep " U "-groove type. All welding was down-hand, using " E.G. Unitrode " low-hydrogen-content electrodes with d.c. power. As the work progressed the 100 hours initially taken to weld each circumferential seam was reduced and a change-over to double " V " preparation was made, with a resultant saving of 35 hours per seam. High-frequency electrical heating was used for stress relief. Special precautions were taken to ensure that the possibility of water leaking into the carbon dioxide circuit should be reduced to the minimum.

The paper includes descriptions of the circulating pumps, steam drums, mountings and fittings and instrumentation. It is emphasised that the need for extensive areas for heat transfer, together with low carbon dioxide pressure drop, led to large overall dimensions and heavy weights. Construction was further complicated by the need for clean conditions within the carbon dioxide primary circuit.

Reactor Control Equipment

When a nuclear reactor is operating at a steady power level the rate of generation of free neutrons exactly equals the rate at which they are lost by absorption or leakage. By matching the size of the system, which determines the leakage rate, to the nuclear properties of the fissile and other materials of construction, an approximate balance may be achieved. However, the conditions determining this balance change during the operation of the reactor and, to allow the level of power to be changed, the balance must be temporarily disturbed. To meet these needs, excess reactivity is built into the core, and neutron-absorbing rods are provided to balance the system. In

their paper which is to be presented this afternoon, Messrs. S. A. Ghalib and J. H. Bowen describe the rods and their associated control equipment.

After dealing with the various control rod schemes which have been examined the authors describe, in some detail, the scheme employed at Calder Hall. Here there are 112 control rod channels in the reactor core, each of 3¼in diameter, the control rods being 22ft long as shown in Fig. 3. The sheath tube, of 18/8/1 stainless steel with low cobalt content, is primarily intended to contain any particles of absorber which may be abraded or corroded from the parent metal. By using the sheath tube as a structural member, the boron steel absorbing material is made in the form of short tubular inserts. The drive is through charge tubes and, as shown in Fig. 3, the cable is attached to the top of the rod so that its removal from a remote position is relatively simple. A spring shock absorber is provided, which supports the rod in the normal lowered position, with the top resting on the charge pan. In normal operation, including emergency shut-down, the terminal velocity of the control rod is less than 6 in/sec, and the spring cushions the final impact.

The average heat generated in a control rod was calculated to be 0·5 kW/ft but a severe gradient of thermal-neutron flux may exist at the tip of a control rod, which was not considered in the calculation. For this reason a generous flow of cooling gas was provided; also, the absorption of the rod tip was graded to minimise the flux gradient. The general arrangement of the driving mechanism is shown in Fig. 4. A synchronous motor drives a winch drum through 20 : 1 gearing. An eddy-current brake controls the speed in emergency shut-down operation. A solenoid operated dogclutch releases in this condition and avoids back-driving the motor. With signalling and indicating devices, this comprises the whole of the driving mechanism, speed and direction being controlled by the electrical supply to the motor.

The detection of faulty fuel elements is dealt with in the paper prepared by Messrs. E. Long, J. M. Laithwaite and K. W. Cunningham who explain that of six possible methods of detection considered for Calder Hall the first three depend upon normal engineering techniques whereas the last three depend upon activity caused by nuclear reactions. For high sensitivity, a nuclear method must select only the reactions associated with a burst can and discriminate against those parasitic reactions which occur in the gas itself.

The "wire precipitator" method was finally adopted in the Calder Hall reactors. This method depends upon the fact that the ionised particles formed in the gas stream by the decay of fission products emitted from a perforated fuel element can may be deposited on to a wire by means of an electrostatic field. Many of these particles are stable and play no further part in the process. Some, however, decay further with the emission of a β particle, and it so happens that this secondary decay is characteristic of those products associated with the fission of uranium, while relatively few parasitic fission products have this property. This method therefore discriminates against unwanted counts. Sensitivity is further aided by the concentrated deposition of active particles on to a short length of wire which permits more efficient counting than when the particles are dispersed throughout the bulk of the gas sample.

Each detection unit serves 212 of the 1,696 fuel element channels in the reactor core by periodic sample via the selection system. A small gas sample from each channel is cooled and filtered before passing to the detection unit. The filter removes almost all solid-fission-product atoms, leaving principally those of krypton and xenon, and it is the presence of these atoms in the sample which indicates the exposure of uranium to the coolant. After it has passed through the detection unit, the gas sample is returned to the main circuit.

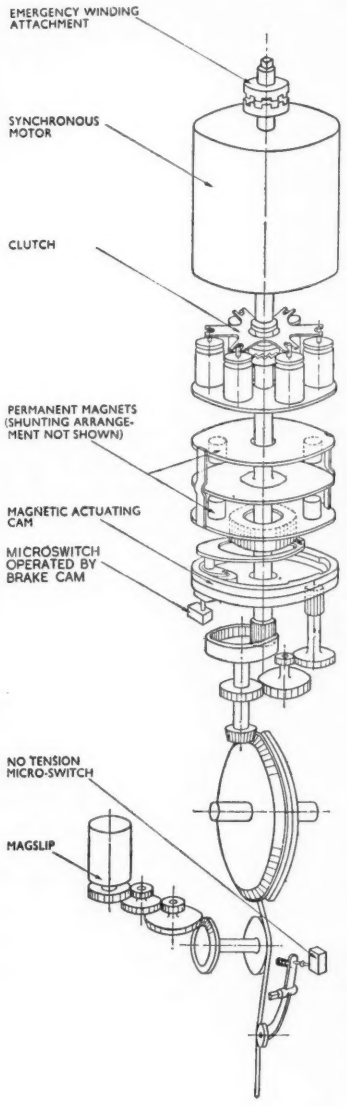


Fig. 4.—General arrangement of the control rod driving mechanism

The detection unit itself consists of two main sections, the precipitation chamber and the counter assembly. The whole unit is operated at a pressure a little below reactor outlet pressure, and is enclosed in a cylindrical pressure casing. An earthed wire passes along the axis of the casing. A theoretical estimate, partially formed by experience on other reactors, shows that the equipment will have sufficient sensitivity to permit four channel samples to be ganged together.

In the following paper Messrs. R. J. Cox and K. R. Sandiford will deal with reactor control and instrumentation at Calder Hall, which combines the rapidly developing field of nuclear reactor technology with the well-established technology of generating electricity by using steam plant. The instrumentation of the turbines and generators follows normal practice, but that of the reactor and heat exchanger includes techniques and equipments which are novel and, in some cases, have been specially developed.

The instrumentation of a power reactor is complicated by the presence of the pressure vessel. Equipment installed inside the vessel must withstand continuously elevated temperatures and a high level of neutron and gamma ray irradiation. Such equipment is difficult to maintain and the gland seals require careful design. On this first plant so many interesting measurements can be suggested that the instrumentation could easily have become excessively elaborate. The permanently installed instruments were therefore confined to the minimum necessary for the satisfactory operation of the plant. Even so, the number installed exceeds 2,500 per station. In addition, a considerable number of primary measuring instruments, such as thermo-couples and pressure tapping points, were installed for use with temporary instruments. The instru-

ments fall conveniently into three categories: (*a*) those for the control of the reactor and of the gas cooling circuit, (*b*) means of detecting and locating faults which may occur and of initiating appropriate correcting action, and (*c*) instruments for the initial adjustment of the plant and for subsequent occasional adjustment.

In the reactor control room a central console allows control of reactor coarse and fine control rods, circulator speed and temperature of coolant returning to the reactor, together with the instruments immediately required for this adjustment. On the instrument panels the central feature is a graphic layout of the main branches of the gas circuit. By this method of display it is hoped to reduce the possibility of confusion between the branches, particularly when discrimination is required under fault conditions.

System Control

System control and production is then to be dealt with by Messrs. E. Anderson and J. H. Bowen who point out that at Calder Hall there is one control room associated with each reactor, with a third adjacent to the turbine house to control the electrical output. This scheme was adopted as being best suited to the requirements of operating each reactor, so far as possible, at full power, the steam utilisation being a separate issue. For the same reason feed and steam systems for each reactor are kept separate, and even the two sides of the electrical system are made as independent as possible. The principal items of running machinery are attended; the less important have their condition indicated to a manned point. Plant is started up locally, but running control of the items such as gas circulators and turbines is then transferred to their respective control rooms.

In equilibrium, the power from the system, of which part is rejected heat, equals that generated by the reactor. The reactor power is regulated by a monitoring loop comprising power-measuring instruments on the reactor-control rods. The loop is completed by a manual operator, but the equipment has been designed to facilitate the installation of an automatic controller if desired. The controls and instruments required by the operator for normal running are on a desk in the reactor control room. By adjusting the lower steam pressure of the dual-pressure cycle, the operator may control the temperature at which the gas returns from the heat exchangers to the reactor, and by adjusting the speed of the main circulators he may control the temperature rise of the coolant gas for a given reactor heat rate. The plant may be operated at any power down to 10 per cent of full load. On part load, if the maximum surface temperature of the fuel elements is held constant, the temperature rise in the gas exceeds its full load value; if, on the other hand, the gas temperatures are held constant, the fuel-element temperature falls. The latter is the preferred method of operation, as this allows constant-temperature working of the pressure circuit; also, a redistribution of uranium temperature occurs with load, which largely offsets any advantage of keeping the fuel element temperature constant.

To establish what might constitute limiting conditions of operation requiring special emphasis in protection, the effects were considered of excessive neutron flux, abnormal temperature gradients, and high temperature levels. It was concluded that fault conditions causing a rise in temperature of the fuel elements required special attention since failure of the fuel element cans might contaminate the CO_2 pressure circuit with active material.

The policy underlying the provision of the trips and interlocking has not been to relieve the operator of the responsibility for the correct operation of the plant. The protection has been designed to deal automatically with those situations which may develop too quickly for the operator to control without risk of damage to the fuel elements. In several cases the correct functioning of these trips requires preparatory action by the operator, and in others the operator must act correctly on a warning being given. In all cases, two completely separate systems of measurements cover a given fault to give an automatic shut-down or a warning in the reactor control room.

Future Developments

In the final paper which is to be presented this afternoon Mr. R. V. Moore is to deal with the development of gas-cooled reactors for power production. He says that the target for this design study of the plant, which eventually became the Calder Works, was a nuclear power station for base-load operation, using natural uranium fuel. The Calder Works was a minor variation of this theme in that emphasis was laid, in the design, on plutonium production. This was achieved without digression from the original purpose and the plant is, in fact, a prototype from which nuclear power stations of continually improving performance will be developed.

It must be remembered, however, that Mr. Moore's paper discusses the possible developments of one particular class of reactor—the gas-cooled graphite-moderated type—and therefore reviews the future on rather a narrow front. These plants, fuelled with natural uranium, however, are a spearhead of the United Kingdom's nuclear power programme.

If the Calder plant was run as a power station, and no value was attributed to the residual plutonium, it would produce electricity at about 1d per kWh. This would not be competitive with coal-fired stations in the United Kingdom and so in future plant this cost must be reduced. Mr. Moore shows that the performance of a power reactor improves rapidly as the designed value of the fuel element temperature is raised, the capital cost per kW of installed capacity is reduced through increased fuel rating, the unit cost being further decreased as the efficiency rises.

The solid rod fuel element, clad in magnesium or aluminium, is reaching the end of its possible development. A new range of reactors is opened up with the introduction of fuel elements with larger surface to mass ratios, and clad with a metal of high melting point. These reactors will probably need initial enrichment, although their design may well enable them to operate on re-cycled fuel with a natural uranium feed. The higher ratings possible with these designs may extend the field of application from base-load power plants to plants producing smaller amounts of power at a worthwhile cost.

Still higher temperature systems may be developed in which metals are excluded from the core, the fuel being ceramic and dispersed in the graphite moderator. Many severe problems are associated with this design, but successful development would lead to still cheaper power and to compact systems for which gas-turbine cycles would be economically feasible as an alternative to steam.

CALDER HALL FILM

A COLOUR FILM of the opening of Calder Hall power station by the Queen has been made by Ace Distributors, Ltd., for the United Kingdom Atomic Energy Authority. Entitled "Great Day," it includes a tour of the station and the switching-on ceremony. The film, a preview of which was given at the Crown Theatre Cinema, Wardour Street, London, last week, runs for about twenty minutes. Arrangements have been made with the Rank Organisation for the showing of the film in this country and it is being translated into eight foreign languages for overseas distribution.

Public Works Exhibition

Mechanical Aids for Local Authorities and Contractors

THE trend in much of the contractors' plant and equipment which was on display at the Public Works and Municipal Services Congress at Olympia, London, last week was towards larger and more powerful machines and among a number of new products introduced for the first time were several of electrical interest. Cranes, conveyors, hoists, loaders, stone crushers, mixers, vibrators and pumps are just a few of the items which are now commonly electrically driven and many of the leading manufacturers have concentrated on improving the design, reliability and general performance of their established models.

A typical example of how electricity helps the builder could be seen on the stand of the British Hoist & Crane Co., Ltd. Here was displayed their "Saga" Mark II power winch, a new type of builder's hoist, for use with tubular steel scaffolding and capable of elevating 15-20 cwt loads at a speed of 150-210 ft/min to a maximum height of 250ft. This company also displayed their larger Mark III winch, with 50 cwt direct line pull, powered by a 20-25 h.p. electric motor. A "Multi-level" loader for handling a variety of material through a wide range of height, with engine or electric drive, was shown by R. A. Lister & Co., Ltd., whose display included a selection of generating sets with outputs from 900 W to 32 kW, including the "Start-O-Matic" plants and pumps for both deep and shallow wells.

Mobile Generating Sets

Among the selection of mobile diesel-alternator sets on view on the Petbow stand was one of the company's "Vulcan" range similar to those now in use by building contractors to supply independent power on site. It is driven by an 8-cylinder Rolls Royce C series oil engine and has an output of 170 kVA, 440 V three-phase 50 c/s. By way of contrast, the Petbow "Buzzard" 1 kW 240 V a.c. portable generating set was shown to illustrate the extent of their complete range. A new and patented design developed to meet the requirements of telecommunication systems if the mains supply fails, was shown in the form of a "No-Break" 7 kVA, 230 V automatic stand-by alternator driven by a Petter AV2 twin-cylinder diesel engine.

Generating sets ranging up to 125 kVA were exhibited by Auto Diesels, Ltd., whose display consisted of many models of particular interest to public works contractors. They also showed a full range of their "Floodmaster" centrifugal pumps, in ¾in to 8in sizes, either engine or electrically operated, as well as portable power units for the operation of electrical hand tools. Among other companies exhibiting diesel or petrol engines, either as standard power units or in a variety of applications, including fork lift trucks and power packs, were F. Perkins, Ltd., Bryce Berger, Ltd., Mirrlees, Bickerton & Day, Ltd., National Gas & Oil Engine Co., Ltd., Petters, Ltd., Ruston & Hornsby, Ltd., and J. & H. McLaren, Ltd. The last-named company had on show one of the latest engines to be added to the Petter-McLaren range, a skid-mounted 100 kW set incorporating a DE6 water-cooled diesel engine, a Brush flange - mounted, flywheel type self-regulating alternator and "Rectifex" voltage control system. The Brush Electrical Engineering Co., Ltd., exhibited a representative motor from their range which covers sizes from 1 h.p. to 1,000 h.p. in addition to alternators and switchgear, including a new design of horizontal draw-out industrial metalclad m.v. circuit-breaker, type I.M.

New exhibitors were Ellis Rees & Co. (Manchester), Ltd., who showed a 110 V petrol-electric generator with an output of 400 W. The smaller types of power units were also displayed by Arthur Lyon & Co. (Engineers), Ltd., who had on view the "Alco 500" 24 V, 500 W d.c. lighting set and a 2·5 kW alternator set giving a 230 V single-phase 50 c/s supply.

The new "Multibrator" frequency changer set shown by C. H. Johnson (Machinery), Ltd., is capable of operating, 300ft from the power unit, four 2½in concrete vibrators, two 3⅜in pokers, or a range of high-frequency electric tools. Its capacity is 3·5 kVA, input 400 V, 3-phase 50 c/s and output 125 V, 3-phase 200 c/s. It is claimed to be unique in that the vibrating motor is actually built into the poker itself. On sites where no power supply exists a "Multibrator" alternator, driven by a petrol or diesel engine but having the same output characteristics, can be used. A new high frequency flexible drive internal vibrator with an electric motor developing 12,000 r.p.m., and powered by a portable generator or frequency changer, was shown by E. P. Allam & Co., Ltd. This machine is claimed to be capable of consolidating the harshest of concrete mixes.

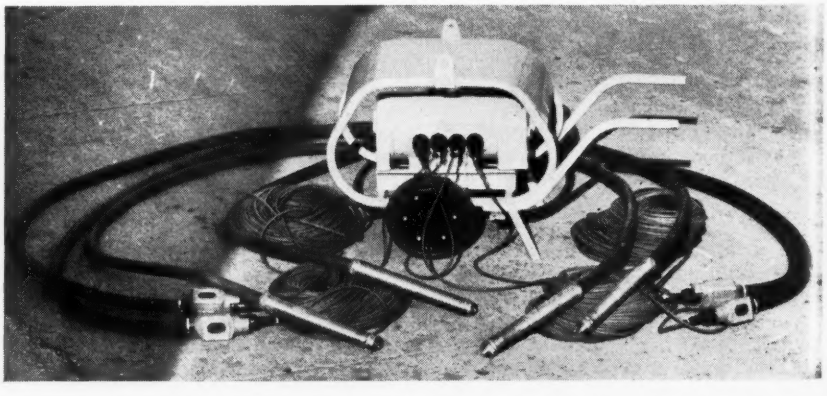
A new portable electric hammer, the "H" type breaker (Kango Electric Hammers, Ltd.) is claimed to be the most powerful of its kind; it is primarily for heavy duty concrete and road breaking and operates either from a normal mains supply or small generating set. The loading is about 1½ kW. Kango also displayed their "F" and "E" type hammers, the latter being suitable for drilling holes up to 3in diameter.

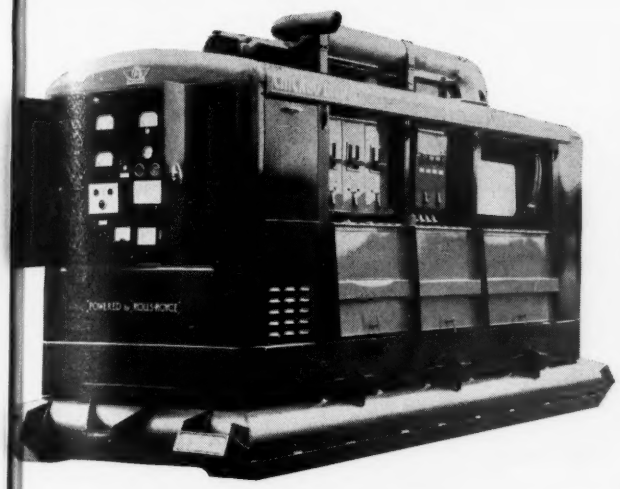
The cartridge fired hammer gun, though not electrically operated, has many applications in the electrical industry and various models were on view. The "Supadynamic" power driving tool was demonstrated by F. H. Bourner & Co. (Engineers), Ltd., and other exhibitors of this type of

Right: Explosive Power Tools

"Rapid-Drill" vibro-electric drill

Below: C. H. Johnson's "Multibrator" concrete vibrator





Petbow "Vulcan" 170 kVA mobile generating set

equipment included the Langham Export Co., Ltd. ("Fix-Rammer"), Roura & Forgas ("Tornada"), and Explosive Power Tools, Ltd. ("Rapid-Hammer"). The last-named company also markets the "Rapid-Drill," a vibro-electric portable hand drilling machine for concrete, brick, stone, etc., and the "Rapid-Mate." This tool, in addition to being suitable for the chasing of channels into brickwork, is capable of sinking holes up to 6in in diameter. Extension spindles enable walls up to 27in thick to be dealt with.

The "Simbi" electro-magnetic hammer, shown by C.E.T. (Equipment), Ltd., has no rotating parts and is supplied complete in a steel carrying case containing the hammer, tools, cable and accessories in the upper section and a transformer, voltmeter and frequency reducer in the lower compartment. Each hammer is insulation tested at 2,000 V and is operated through the transformer at 42 V. Electricity consumption is in the region of 200 W. Also seen on this company's stand was the "Coupleflex" all-rubber cable coupler. Consisting of a flexible lead with a plug at one end and a socket at the other, it has been designed for portable power and lighting installations where complete safety is essential. It is, at present, available in 5 A size only, but can be supplied in any length.

A recent addition to the range of powered saws and hedge cutters was shown by Teles Smith, Ltd. This was the "Teles Tiger" hedge cutter which has a cutting length of 14in and weighs only 6 lb. It is available for four voltages, 12, 105/115, 200/220 or 230/250. A two-man chain saw, intended principally for timber yards and powered by an electric motor, was also displayed. The Tarpen Engineering Co., Ltd., exhibited for the first time their "Tarpensaw" portable chain saw which cuts up to 10in and weighs 14½ lb.

The battery-operated electric vehicle is eminently suitable for refuse collection and one of the latest models was shown by Sidney Holes Electric Vehicles. A pedestrian controlled street orderly truck, it is one of the company's "Manulectric" range and is designed to carry twelve 3½ cu ft portable bins. Lewin Road Sweepers, Ltd., and the Harborough Construction Co. exhibited similar street cleansing trucks.

Road signs, guard posts, external lighting fittings and the "Duopark" two-in-one car parking meter were displayed on the Gowshall stand. Venner, Ltd., had on show their "Park-O-Meter," an automatic type which does not require a handle to be turned after inserting the coin.

Registration and Inspection

NOW that the National Inspection Council for Electrical Installation Contracting has begun operations, the National Register of Electrical Installation Contractors which, in a sense, it supersedes, is to go into voluntary liquidation at the end of the year.

As we have already reported, the National Inspection Council is to compile and maintain a Roll of Approved Contractors. Initially, this will include all holders of the N.R.E.I.C. certificate, members of the English and Scottish Electrical Contractors' Associations and Area Electricity Boards, in respect of their contracting departments. It is expected that there will be between 3,000 and 4,000 original entries.

Future registrations will be made only by approval of the National Inspection Board after full investigation based on reports by its inspectors. Applicants for admission to the Roll will be required to have had sufficient technical training and experience to ensure that their work is safe and of an adequate standard; to possess suitable equipment; and be of sound business status. Provision is made for the admission to the Roll of other applicants who in the absence of these qualifications employ a "qualifying manager."

The work of approved contractors will be periodically inspected to make sure that standards of workmanship are maintained in accordance with the Council's rules. These rules require the maintenance of a standard comparable with that represented by the 13th edition of the I.E.E. Wiring Regulations.

Approved contractors undertake to pay the rates of wages and observe the working rules and conditions of employment applicable to the electrical operatives in his employ as laid down by the appropriate National Joint Industrial Council.

On application for enrolment a fee of three guineas is payable; this, if the applicant is accepted, covers enrolment for one year and thereafter an annual renewal fee of three guineas is payable. The Council has the power to remove any approved contractor from the Roll for breaches of his obligations, for carrying out unsatisfactory work, for non-payment of renewal fee, etc. It is provided that decisions of the Council can be appealed against to a specially-convened tribunal.

Contractors admitted to the Roll will receive a certificate of enrolment, and dies, electros and printing blocks will be available of "such mark, emblem or device as the Council may approve"; these will be returnable if the contractor is removed from the Roll for any reason.

Information relating to the Council may be obtained from the chief executive and secretary, Brigadier W. G. S. Thompson, O.B.E., 13, Victoria Street, London, S.W.1.

We reproduce the emblem of the National Inspection Council, blocks of which will be available very shortly in various sizes. These blocks will include the words "Approved Contractor(s)" in a rectangular box immediately below the emblem.

Mr. S. E. Goodall, M.Sc.(Eng.), M.I.E.E., chief engineer of W. T. Henley's Telegraph Works Co., Ltd., has been appointed to the National Inspection Board as representative of the Institution of Electrical Engineers in succession to the late Mr. P. V. Hunter. In pursuance of a decision by the Board to include a representative of manufacturing interests in its membership it invited the British Electrical and Allied Manufacturers' Association to nominate a representative. The B.E.A.M.A. has accepted the invitation and nominated Mr. G. H. Bayliss, A.C.G.I., A.M.I.E.E., M.I.W.M., technical director of Wm. Sanders & Co. (Wednesbury), Ltd.

Long-Distance Radio-Telegraphy

Recent Post Office Research Reviewed

SIX papers presented before the Institution of Electrical Engineers' Radio and Telecommunication Section on 14th November by Post Office research engineers dealt with various aspects of radio-telegraph systems. These papers with their authors were: (1) Frequency Diversity in the Reception of Selectively Fading Binary Frequency-Modulated Signals (J. W. Alnatt, E. D. J. Jones and H. B. Law); (2) An Investigation of the Spectra of Binary Frequency-Modulated Signals with Various Build-up Waveforms (Allnatt and Jones); (3) An Improved Fading Machine (H. B. Law, F. J. Lee, R. C. Looser and F. A. W. Levett); (4) The Detectability of Fading Radio-Telegraph Signals in Noise (Law); (5) Signal-Noise Performance Rating of Receivers for Long-distance Synchronous Radio-Telegraph Systems using Frequency Modulation (Law); and (6) Laboratory Test Equipment for Synchronous Regenerative Systems (C. G. Hilton, H. B. Law, F. J. Lee and F. A. W. Levett).

The authors of the first paper submitted that failure of transmission when the signal faded on either mark or space frequency might be prevented by exploiting this diversity. An experimental demodulation equipment was described which complied reasonably closely with a mathematical specification for an ideal receiver. The effective bandwidth was reduced almost to the limit by the use of linear-build-up band-pass filters to respond to the mark and space frequencies.

In Paper 2 a straight-line waveform was stated to be the best for transition between mark and space frequencies in frequency-shift radio-telegraphy since it involved the minimum bandwidth for a given total build-up time. Paper 3 described the modification of a cyclic fading machine to give substantially random fading with a signal amplitude corresponding to the Rayleigh distribution.

In Paper 4 an ideal receiver was defined as one that interpreted each element of a received signal with the minimum probability of error. In the design proposed the output branches were combined and weighted according to signal energy instead of being selected for the largest output. The fifth paper showed that error liability after regeneration of the output of a limiter-discriminator frequency-modulation receiver, when fed with steady signals plus noise, could be described in terms of a simple exponential relation involving a single parameter characterising the receiver performance. Present practice of specifying performance in terms of telegraph distortion with an allowance for associated line tails caused appreciable waste of channel capacity. The advantages of regenerative methods of measuring performance formed the subject of the final paper. An error-counting equipment had been devised in which errors passed through a system under test and were compared with perfect signals from the signal source. The suggestion was made that performance of regenerative systems ought in future to be specified in terms of element-error liability.

DISCUSSION

Opening the discussion on the papers, Mr. A. W. Cole (Marconi's Wireless Telegraph Co.) recalled earlier but unpublished work before the war on a system known as double-frequency keying, where full advantage was taken of frequency diversity characteristics. Although both Cable & Wireless and Western Electric had produced receivers of this general type the technique had then been dropped and developments since the war had been based on the limiter-discriminator type of receiver, which had considerable disadvantages in not making full use of the information contained in the signal. The trend to the authors' type of detector would be a benefit, and his organisation had already operated it on ionospheric scatter circuits. It had reduced the error rate to about 20 per cent of that obtained with the limiter-discriminator circuit.

Mr. J. Heaton Armstrong (Standard Telephones & Cables) said it was a feature of the authors' system that during flat fading the condenser charges cancelled out, so that the system did not introduce any blocking. Blocking could occur, however, with very fast selective fading, and it was a weakness of the system that selective fading on strong signals might cause errors which would not occur with the conventional system.

Mr. J. W. Allnatt (P.O. Research Station) agreed that under conditions of good signal/noise ratio the authors' technique would be inferior to existing techniques when there was fast selective fading, but he said that in the authors' experience such fading was very rare.

Mr. C. F. Booth said that the authors' equipment would be extremely useful in the future in making those improvements at the receiver which would be necessary to extract the maximum information from the transmitted and received signal and should provide a firm basis for comparing the performance of various types of equipment. New developments had usually to be paid for in some way, and in the present case something had to be paid in respect of the frequency stability of the transmitter. The authors stated that the mutual frequency difference between transmitter and receiver should not exceed 25 c/s, which for a transmitter working on 15 metres meant a frequency difference of 1 in 10^6, to be divided between transmitter and receiver. That was achievable, but it contrasted with the internationally agreed tolerance for transmitters in that range of 30 in 10^6.

Mr. Terry questioned the assumption, which seemed to run through all the papers, that fading must be slow. If one took the record of fading throughout the day, no doubt the authors were right, but what was of interest was what sort of fading would occur at the time when the ordinary receivers were packing up. He was inclined to believe that at these bad times the fading was fast.

Mr. H. B. Law (P.O. Research Station) replied that if there was a great deal of rapid fading he thought that the authors' system was going to fail. Their observations suggested that rapid fading was rare, though they had heard it on propagation groups going through the auroral zone.

Mr. C. W. Earp described some work which led him to take the view that if it was possible to afford extra bandwidth one could use one receiver to commutate rapidly round a number of aerials, determine which was the best and connect another receiver to that aerial.

Mr. J. A. Smale (C. & W.), as one who had taken part in the early work referred to by Mr. Cole, said the reason why it failed might be that they had not had more selective filters, or, more probably, that they had not been able to use them because they had not had sufficiently stable frequencies of transmission.

Dr. R. L. Smith-Rose referred to the work which had been done during the past 25 years to obtain a systematic knowledge of the ionosphere as a reflecting medium above the earth. It had been suggested that the existence of the ionosphere was a blessing, but he thought it had been a very mixed blessing. The world might have been a happier place if there had been no such thing as the ionosphere; one result might have been that there would have been a trans-atlantic cable many years earlier.

Activity in China

Vast Possibilities in an Underdeveloped Country

By R. E. KAAN, Dipl.Ing.

CHINA'S industrial rehabilitation and expansion is being achieved under conditions of trade embargoes by the Western World, and without British, American or West German financial aid or technical assistance. Though China cannot be regarded as a Soviet satellite, she is politically and economically tied to Russia, so long at least as she has to rely on Russia for the supply of material and technical advice for her vast industrialisation programme. In spite of the fact that China's total trade during the last five years has nearly doubled, her trade with the Western Countries has been halved, and thus her dealings with the Eastern bloc represent 75 per cent of her total exports. Her trade outside the Eastern bloc is conducted in transferable sterling and balances accruing from remittances of Chinese emigrants. Table 1 shows China's main electrical Western suppliers, with Switzerland in the lead.

Competition in the Chinese market is already in full spate. Russia, her satellites, and "uncommitted" countries, like Sweden and Switzerland, have entered into one of the United Kingdom's most promising markets.

United Kingdom electrical exports to China (Table 2), in spite of the vast prevailing market possibilities for electrical goods, are on a small scale, thus necessitating an early expansion of trade between the two countries. Nevertheless, the figures for the first half of this year (£87,400) reveal an upward trend. As in the past, instruments and electro-medical supplies account for the bulk of United Kingdom exports.

China's first Five-Year Plan is mainly concerned with the installation of regional power stations, hydro and thermal, of comparatively large capacity to be interconnected throughout the country by means of high-voltage grid systems. The supply of equipment and the necessary technical assistance for the realisation of these plans is coming from Russia, her satellites, Switzerland and Sweden. Among the numerous schemes assisted by the Russians by the provision of finance, personnel, or designs, were fifteen 50 MW steam power stations. Poland has contented herself so far by supplying electrical equipment for a number of substations, and "packaged" diesel-generator sets for collective farms.

Detailed figures of the most successful United Kingdom competitors in the Chinese market are contained in Tables 3 to 5.

Table 3 shows that Switzerland within one year managed to increase her electrical exports to China by about 20 per cent. Heavy plant and ancillary power station equipment played an important part. Western Germany, while losing ground generally, increased her exports of prime movers considerably. Though the official Swedish trade figures do not specifically mention prime movers in connection with exports to China, it is reported that Sweden, in common with East Germany, booked orders for the delivery of several turbo sets.

Japanese electrical exports to China during 1954 mainly consisted of electronic tubes, and instruments. The figures were as follows:—Motors, 100-500 kg, £52; motors, 1,000-5,000 kg, £1,667; radio valves, £14,309; other valves; £2,214; indicating instruments, £5,078; meters,

TABLE 1.—CHINA'S ELECTRICAL IMPORTS FROM WESTERN COUNTRIES (£000)

Country	1954	1955
United Kingdom ...	92	63
W. Germany	153	114
Sweden	22	97
Switzerland	225	267
Italy	98	12

TABLE 2.—U.K. ELECTRICAL EXPORTS TO CHINA (INCLUDING FORMOSA)

Class	Year 1954	Year 1955	First half 1956
	£	£	£
Steam and water turbines	—	—	1,100
Motors	8,700	8,000	—
Control gear	700	—	300
Transformers	—	—	1,800
Switchgear	—	700	—
Rectifiers	—	—	1,500
Welding plant and electrodes ...	16,100	20,800	3,500
Heating, cooking & domestic appliances	1,500	200	—
Refrigerators	—	700	6,300
Fans	1,700	—	—
Instruments and meters	34,000	12,400	54,400
X-ray and elec. medical appliances ...	28,400	20,400	18,100
Total, including miscellaneous ...	92,100	63,200	87,400

TABLE 3.—SWISS ELECTRICAL EXPORTS TO CHINA (£000)

Class	1954	1955
Water turbines and pumps	not available	51
Steam turbines	17	28
Rotating elec. machinery	50	47
Control apparatus	75	54
Elec. equipment above 500 kg	1	28
" " between 50–500 kg	12	9
" " " 3–50 kg	9	10
" " " 0·3–3 kg	4	5
" " under 0·3 kg	3	1
Electrodes	5	9
Cables	2	4
Copper wire	6	3
Telephone and telegraph apparatus	2	1
Record players and projectors	13	11
Total, including miscellaneous	225	267

TABLE 4.—SWEDISH ELECTRICAL EXPORTS TO CHINA (£000)

Class	1954	1955
Motors and generators	—	5
Oil circuit-breakers	—	32
Power tools	3	—
Pumps	—	2
Lamp filaments	6	21
Carbon brushes	2	—
Electro-medical appliances	6	1
Condensers and parts	1	28
Relays and parts	2	3
Cutting and welding machinery	—	3
Total, including miscellaneous	22	97

TABLE 5.—W. GERMAN ELECTRICAL EXPORTS TO CHINA (£000)

Class	1954	1955
Steam turbines	7	53
Generating sets	17	—
Transformers	1	5
Power tools	11	—
Elec. vehicle equipment	16	—
Welding equipment	—	1
X-ray equipment	14	16
Electro-medical appliances	11	22
Telephone apparatus	8	—
Telegraph apparatus	3	—
Wireless telegraph and telephone equipment ...	4	—
Scientific instruments	2	9
Total, including miscellaneous	153	114

£15,263; variable condensers, £4,842; arrestors and dischargers, £116; bells and horns, £2,012; control and safety apparatus, £588; total, including miscellaneous, £48,141.

It appears that every competitor is all out to get orders for pilot plants determining future quantity orders and is making full use of the exchange of technical missions.

China, following the Russian and Japanese example of using low-grade coal for fuel, is fostering her own steam turbine production considerably. According to the first Five-Year Plan, she should be able, by the end of 1957, to manufacture certain heavy plant and ancillary equipment (see Table 6).

China's second Five-Year Plan affords vast opportunities for the United Kingdom electrical manufacturer, particularly in connection with the proposed multi-purpose schemes on the Yangtze, Sungari, Sinan, and Yellow Rivers.

In the absence of any significant changes in the embargo list within the second Plan, starting in 1957, the chances of the long awaited expansion of Sino-British trade are extremely small as exporters cannot reckon with certainty whether export licences under the " Exception Procedure " will be available for any particular contract. This Procedure provides that a member of the " Consultative Group Co-ordinating Committee " (C.O.C.O.M.), a body administering the United States' Battle Act, may act unilaterally, provided that, in the member's opinion, circumstances warrant it. But this action must be justified to the C.O.C.O.M. Council. Although there might be a way of increasing United Kingdom exports to China of electrical goods not on the Russian embargo list, some rearrangements of Chinese purchasing programmes and assurances of the continuity of concessions might be required by China, before a substantial increase in trade could result.

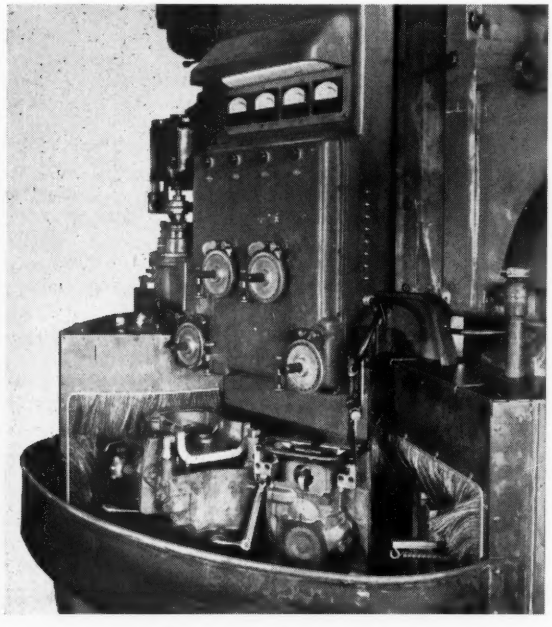
Apart from substantial quantities of heavy electrical plant and material required for China's ambitious plans, there will be important outlets for distribution and telecommunication equipment in connection with the planned electrification of the large collective farms, and for sounding apparatus for China's large fishing fleet. It can reasonably be expected, that during the next two years, China will begin to negotiate contracts on a very large scale.

TABLE 6.—CHINA'S FIRST FIVE-YEAR PLAN (1952-1957)

Reading	Unit	Production in 1952	Target 1957
Power	MWh	7,250·0	15,900·0
Steam turbines	MW	—	85·0
Water turbines	MW	6·7	79·5
Motors	MW	63·9	1,048·0
Generators	MW	29·7	227·0
Transformers	MVA	1,167·0	2,610·0

Motor Load Indicators

AN interesting application of ammeters which is being applied in some United States establishments is to motor load per cent indication, in which role they function to increase the efficiency of modern machine tools in different ways. These ammeters, as provided for use on some machine tools, are equipped with a pointer travelling over a scale which has a range from zero to 150 per cent of motor load. To indicate danger more readily and give warning of motor overloading, the scale is in red from 125 to 150 per cent.



Mattison multiple vertical-spindle grinder equipped with ammeters indicating motor load percentage

One function of such indicators occurs where several of them are arranged side by side at the operating station, each corresponding to one of a number of similar drive motors on a machine. An example of this is on a drum sander, where each drum of a multiple-drum machine has its own motor, and an ammeter shows the load on each drum motor. Thus, an operator can tell when each of several drums is performing its proper share of the work, by comparing loads on the different motors as shown by the ammeters.

Another machine tool on which this arrangement has been found advantageous is the surface grinder of the multiple vertical-spindle type, where each spindle is individually driven. Here the ammeters will allow each spindle to be set for the correct motor work load for the operation it is to perform.

Machine manufacturers find such ammeters profitable since they prevent over-motoring. In operation, where a load cycle varies, the machine operator can tell how heavy a cut to take and how fast a feed to use to employ his machine to the greatest consistent advantage. Obviously, motor loads on machine tools increase as tools dull. With this in mind, a number of manufacturers now use ammeters to determine when tools should be re-sharpened or replaced. In this way, the ammeter functions as a quality control instrument.

In similar fashion, wheel-dressing time on multiple-spindle grinders can be determined. The growing load on a motor under operating conditions, caused by wheel grits dulling, allows an operator to run his wheels until he reaches a predetermined ammeter reading before dressing them. In this way the dressing operation is so controlled that no unnecessary wheel waste is involved by dressing too often; by the same token, the method ensures that dressing will be performed sufficiently often to keep wheels in good working condition.

INDUSTRIAL NEWS

Approved British Equipment in Canada

The B.S.I./CSA Approvals Agency operated by the British Standards Institution on behalf of the Canadian Standards Association has published a supplement to the 1956 edition of its directory of United Kingdom manufacturers who hold CSA approval. The supplement contains more than fifty entries describing British firms whose products have been newly approved, those firms who now have received extended or modified approval for additional products, and those whose approval has been cancelled. This supplement is being sent to all companies who hold CSA approval, to companies who use approved equipment as part of their own products, and to trade organisations. In Canada the list will be circulated by the CSA Approvals Laboratories to all the Provincial chief electrical inspectors. Supplies are also being sent to all United Kingdom Trade Commissioners in Canada. Further copies are available, free of charge, from the B.S.I. Sales Branch, 2, Park Street, London, W.1.

F.B.I. Register

The 1957 edition of the "F.B.I. Register of British Manufacturers" is a comprehensive guide of British industry and lists the products and services of over 7,000 member firms under more than 5,400 alphabetical headings. In addition to the classified buyers' guide there are seven other sections, giving addresses of companies and firms, information about trade associations, proprietary names, trade marks, etc., and there are French, German and Spanish glossaries of British product terms giving translations of every product term used in the main buyers' guide. The Register is published for the Federation of British Industries by Kelly's Directories, Ltd., and by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 42s post free.

Lamp Price Reductions

Reductions in the prices of their colour-corrected mercury fluorescent lamps (type MBF/U) are announced by members of the Electric Lamp Manufacturers' Association. The new prices are £4 19s for the 250 W lamps and £6 10s for the 400 W lamps.

Rhodesian Locomotive Order

The Rhodesia Railways have ordered a further twelve 2,000 h.p. diesel-electric locomotives from the English Electric Co., Ltd. This repeat order follows shortly after the completion by the company of the original contract for twenty-three locomotives of the same design. They are claimed to be the most powerful diesel-electric locomotives ever built for a narrow gauge railway. The first locomotive went into service with Rhodesia Railways in June, 1955, and the last of the original order was inspected at the company's Preston works by Sir Roy Welensky, then Minister of Transport and Communications, when he visited Britain in May.

Electricity and Clean Food

Cleanliness in every department of food handling and preparation is required by the Food Hygiene Regulations which recently came into force, and the British Electrical Development Association has published a 12-page illustrated brochure entitled "The Clean Way to Clean Food," in which it shows how electricity provides the means of complying with the regulations in order to secure completely hygienic conditions in shops, restaurants, cafés, canteens, and factories, and in all places where food is prepared, processed, cooked, and served or sold to the public.

There are six main sections which deal respectively with the use of electricity for providing hot water, for dish washing, for floor cleaning, lighting, food storage and pest control. Copies of the brochure can be obtained from Electricity Boards or direct from the Electrical Development Association at 2, Savoy Hill, London, W.C.2.

Atomic Power for Japan

A group representing the Japanese Atomic Energy Commission has been visiting a number of establishments in this country, including Harwell, Risley and Calder Hall, and has had contacts with the Central Electricity Authority and industrial companies engaged in nuclear power development. As a result the delegation is reported to have come to the conclusion that the Calder Hall type of station is more suited to Japanese conditions than designs offered by American concerns. An atomic power agreement between this country and Japan is being discussed.

Synchronous Clock Conference Dissolved

Because, it is said, of difficulties in formulating a common trading policy to meet the requirements of the jewellery and electrical trades, with their varying interests, it was recently decided to dissolve the British Synchronous Clock Conference. The date of formal dissolution was 30th October. The possibility of setting up a new organisation, with broader terms of reference, is to be explored.

Scottish Building Centre

The reopening of the Electrical Section at the Scottish Building Centre, Sauchiehall Street, Glasgow, took place at an informal gathering on 9th November when the E.D.A., the South of Scotland Board and the Building Centre joined to entertain the Press. Situated on the first floor of the Centre the Electrical Section is designed as an information and demonstration point for architects, builders, and for the general public.

Mr. U. F. Murray, assistant chief commercial officer of the South of Scotland Board, in welcoming the guests, outlined the scope of the Centre. The immediate show was concerned with the domestic market but it was their intention to change the displays each three-month period and to concentrate in that period on specific aspects, which might be domestic, commercial or industrial. He drew attention to some of the more recent introductions on show, floor heating as used in the Kirkcaldy multi-storey flats, infra-red mounted wall

Part of the Electrical Section at the Scottish Building Centre

heating, modern cookers of the automatic type and the recently introduced "Debonair" spin dryer, as examples of electrical industry enterprise.

With Mr. Murray were Mr. H. I. Hume, assistant chief commercial officer on the development side, Mr. J. Fraser, Press officer, E.D.A., Mr. B. Vickers and Mr. I. L. Watson, of the Board Press and publicity staff.

A new "Lumenated" ceiling section has been added above the main display walls to give increased visual impact and small sectionalised displays have been incorporated, to give emphasis to the more recent introductions in the domestic field. The present show is devoted to cookers, water heaters, refrigeration, floor heating and space heating.

Transformers for New Zealand

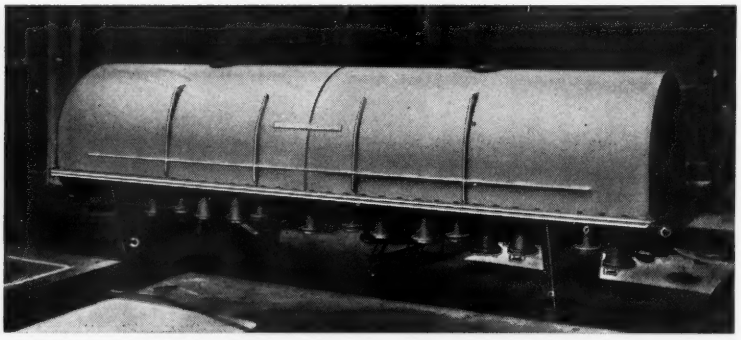
The New Zealand State Hydro-Electric Department has placed an order with the Metropolitan-Vickers Electrical Co., Ltd., for transformers with a total capacity of 80,000 kVA. They are to be installed at Wairakei power station, which is the first station in the country to use natural steam obtained by boring. The station will have an output of some 69,000 kW and will be linked by 220 kV transmission lines to Whakamaru, 25 to 30 miles away, where four 25 MW Metropolitan-Vickers waterwheel generators are in service. It will also be interconnected with a number of hydro-electric stations supplied with water from the Waikato River, close to the Wairakei site.

The new transformers will consist of seven single-phase units, forming two 40,000 kVA three-phase groups with one spare unit. The voltage ratio is 11/220 kV, and off-circuit tappings will be provided for 225 and 230 kV on the h.v. side. The transformers will be cooled by pumping the oil through oil-to-water heat exchangers. The cores will be made of cold reduced grain-oriented directional sheet steel for low losses and reduced size.

Vacuum Tank for Nuclear Research

The accompanying illustration shows a tank which was recently shipped to Geneva for use with the 50 MeV proton linear accelerator which is being constructed by Metropolitan-Vickers for the European Council for Nuclear Research. Three such tanks are required, the total volume being some 50,000 litres. They will be continuously evacuated by five mercury diffusion pumps of a type recently developed by the company, refrigerated baffles being used to prevent the migration of mercury vapour into the tanks. Separate "rough" pumping systems will be used to obtain the degree of vacuum necessary before the mercury pumps can come into operation. For shipment, each tank is filled with an inert gas to prevent corrosion during transit and erection.

Metropolitan-Vickers vacuum tank for nuclear research



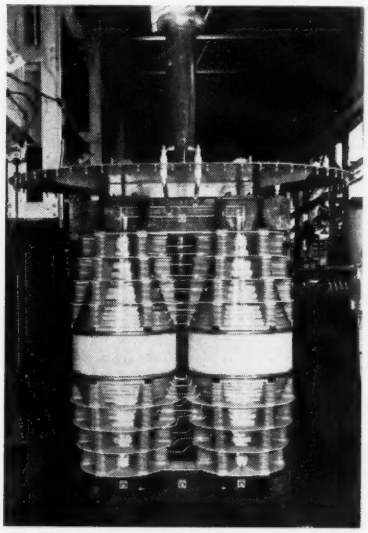
Brush Canadian Company

A new company, responsible for the sale in British Columbia, the Yukon, Alberta and Saskatchewan of all Brush Group products manufactured in the United Kingdom, has been incorporated in Vancouver under the title Brush Group Sales (Western Canada), Ltd. It has been formed to enable the executives of Vivian Diesels & Munitions, Ltd., the Group's manufacturing subsidiary in Vancouver, to concentrate on the engineering business of that company. The directors of Brush Group Sales (Western Canada), Ltd., are Mr. D. Dewar (chairman) and Mr. G. E. Hirst (managing). The responsibilities of Brush Aboe (Canada), Ltd., the Group's sales company in Toronto covering Eastern Canada, are unchanged.

High Voltage Transformers

Nearly 10,000 separator blocks cast in silica-filled Bakelite polyester resin are being used in the manufacture of 100 high voltage testing transformers destined for the export market. The polyester resin blocks have been specially designed by the manufacturers, Foster Transformers, Ltd., for locating the winding formers and to ensure rigid clamping. The blocks are spaced equally around the perimeter of the winding formers, one above the other throughout the entire depth of the winding. Their use enables a considerable amount of external support and bracing to be eliminated, thereby appreciably reducing the man-hours normally required for assembly, whilst at the same time adding to the efficiency of the design.

The transformer is a 150 kVA, 900/250 V model intended for testing electrical equipment and insulation in power stations. The main body of the transformer is suspended in an oil filled tank for cooling and insulating purposes. The complete unit weighs about 3½ tons.



Nearly 100 polyester resin separator blocks are employed in this Foster h.v. testing transformer

Apart from its considerable mechanical strength, good electrical characteristics and resistance to the oil used for cooling the transformer, polyester resin has the advantage that the comparatively complex shaped blocks can be cast from it in one operation, thus avoiding the need for further finishing.

Portuguese Telecommunications Network

A contract, the British share of which is in excess of £1,600,000, has recently been placed by the Portuguese Administration, Administracao Geral dos Correios, Telégrafos e Telefones (CTT), with Standard Telephones & Cables, Ltd., for the provision of a comprehensive telecommunications network between Lisbon and Oporto and other localities in the presidency. The project, jointly planned by engineers of the CTT and the "Standard" organisation, embraces the supply and installation of equipment to provide telephone, telegraph and broadcast circuits and the provision of the necessary cable system. Manufacture of the equipment will be shared between Standard Telephones & Cables, Ltd., and its associates, Standard Electrica, Lisbon, and will proceed concurrently in Great Britain and Portugal.

Two cables are being provided over a route of some 400 km, consisting of a 6-tube coaxial cable of the latest

type, with a parallel cable for short-distance audio and carrier-frequency circuits. The backbone of the network will be a multi-channel carrier telephone system with a capacity of 960 two-way high-grade telephone circuits over two tubes of the 6-tube coaxial cable. The main stations will be situated at Lisbon and Oporto, and with suitably-spaced repeater and terminal equipment, the system will directly serve towns on the route such as Torres Novas and Coimbra. Local circuits will be served by the auxiliary cable installed at the same time as the coaxial cable. For spur-line working 12-channel open-wire carrier telephone systems and 12-channel 2-wire carrier-on-cable telephone systems operating over lines will be provided.

In addition to the carrier telephone circuits, equipment will be provided for teleprinter service between various points in the network. Over cable circuits amplitude-modulated v.f. telegraph systems will be employed, while frequency-modulated systems will be used on open-wire lines. Programme channels between the main broadcasting studios in Lisbon, Oporto, and Coimbra, other programme sources and various regional transmitters, will be provided by broadcast channelling equipment and repeaters.

Under the present contract 744 circuits will terminate at Lisbon, 684 of which will be two-way carrier telephone channels. Direct carrier telephone channels between Lisbon and Oporto will number 204, and a total of 522 circuits will terminate at Oporto. The scope and extent of the whole undertaking is such that three stages of manufacture and installation will be involved covering a period of approximately two years.

Christmas Sales Aids

A gaily-coloured revolving Christmas tree, sparkling with light and carrying the "Atlas" message, has been produced as a display novelty by Thorn Electrical Industries, Ltd. The tree consists of a paper cone mounted on a central spindle over a 40 W lamp. Warm air escaping through a series of angled ventilating slots causes the cone to revolve. The display is available to "Atlas" lamp retailers through any of the area sales offices of the Thorn organisation.

An attractive Christmas pack which converts into a child's toy travelling bag is being used by Philips Electrical, Ltd., for its "Argenta" lamps. Designed for two 60 W or two 100 W lamps, the pack is of strong cardboard, printed in red, yellow and blue. When the lamps are removed the top flaps of the pack form the handles of the bag. The perforated sections divide into railway tickets, a luggage label which fits into slots in the side of the bag, and seven shillings in cardboard money.

Jack Hulbert signs up for an electric washing machine in one of the new E.D.A. films

Motor-operated Lock Gates

Experiments in the electrical operation of lock gates are being carried out by the Thames Conservancy Board, reports the *Evening News*. Motors have been installed at the Maple-durham (near Reading) lock and the new system is expected to be in regular use in about a week's time. The Cookham lock is being reconstructed and the gates will be electrically operated when it reopens in March. It is stated that the Thames Conservancy Board contemplates the conversion of other locks on the river in due course.

Three New E.D.A. Films

Last week we attended a preview of three films which have just been added to the film library of the British Electrical Development Association. Mr. J. I. Bernard, E.D.A.'s chief technical officer, pointed out that these films represent an attempt to be "different" and they are certainly good examples of three distinct techniques. In the first (in colour), with the title "How to Sell Your Husband a Washing Machine," Cicely Courtneidge and Jack Hulbert put over a quick-fire well-timed dialogue which should prove very popular. Although designed for "special" audiences it seems the kind of film which might do well in public cinemas, although its length (18 minutes) would probably militate against its acceptance for this purpose.

The second film, "Into the Light" (17 minutes), employs a modern idiom and will best be appreciated by the younger generation. It takes the form of a musical fantasy in which the need for adequate lighting is stressed in a mime to continuous dance rhythm by Spike Hughes; Gilbert Harding provides a commentary.

The cartoon form is used for the third film, "Cool Custom" (10 minutes), which deals with refrigeration from the Ice Age to modern times in an amusing fashion.

Copies of these, and earlier films produced by E.D.A., are available on free loan upon application to Mr. V. W. Dale, director and secretary, British Electrical Development Association, 2, Savoy Hill, London, W.C.2.

Right: "Atlas" Christmas lamp display

Below: "Argenta" Christmas lamp pack of Philips Electrical, Ltd.

Hoover University Scholarships

Beginning early next year, Hoover, Ltd., are to award three university scholarships annually, two for honours degrees in electrical engineering and one for an honours degree in mechanical engineering. The scholarships, tenable at Southampton University, will each be worth about £1,900 over the full period of study. In addition, the company will award four exhibitions annually for courses at technical colleges for diplomas in technology.

These will each be worth £1,200 over the period of study. The scholarships and exhibitions will be open for competition to sixth form pupils at public and grammar schools who have attained university entrance examination level.

Full details may be obtained from the Education and Training Officer, Hoover, Ltd., Perivale, Greenford, Middlesex. Applications must be received by 8th December for examinations in the following March.

Cable for Kariba

The Federal Power Board of Rhodesia and Nyasaland has authorised an order to be placed with British Insulated Callender's Cables, Ltd., for 33 kV cable to connect the underground power house of the Kariba hydro-electric scheme to the overhead transmission lines. One of the special features of the installation requires the cables to be installed in a vertical shaft 525ft deep.

B.I.C.C. single-core oil-filled cable (specially reinforced on account of the high head of oil) has been selected by Messrs. Merz & McLellan, the consulting engineers. Three circuits each consisting of three single-core 330 kV oil-filled cables will be provided, each having an impulse level of 1,500 kV and a current rating of 500 A.

These cables will be manufactured at the company's Erith Works where the replanning and rebuilding of the power cable factory will enable the production of this type of cable to be carried out in accordance with the specific requirements of the Federal Power Board. The first consignment will be dispatched in September, 1957.

The site conditions at Kariba involve a number of unusual installation problems which will be engineered by the British Insulated Callender's Construction Co., Ltd.

Technological Awards

The National Council for Technological Awards now has its own premises at 9, Cavendish Square, London, W.1 (telephone: Museum 1978). Lord Hives, C.H., is chairman of the Council, which is an independent self-governing body formed to create and administer awards in technology for students in technical colleges who successfully complete higher technological courses approved by the Council. The secretary is Mr. F. R. Hornby, M.B.E., M.A.

Gauge and Tool Makers

The annual report of the Gauge and Tool Makers' Association, which was presented at yesterday's annual meeting, shows a further increase in membership which now stands at 332 firms. Close contact has been maintained with Government Departments and co-operation has continued with other trade organisations. The sixth competition in craftsmanship and draughtsmanship for apprentices and learners was held during the year. Sixteen of the applications received for the certificate of craftsmanship were approved by the Education and Apprenticeship Committee, and two were accepted for the certificate of gauge and tool design and draughtsmanship.

As a result of the Export Committee's representations, all bilateral trade agreements initiated or received by Great Britain have included separate and adequate quotas for the export of British tools and gauges. During the year a close liaison was established with the British Iron and Steel Research Association under which the latter has agreed to render assistance to G.T.M.A. members in problems affecting the properties and uses of steels employed in the gauge and tool industry.

New Automation Company

It was announced in May last that the General Electric Co., Ltd., and the British Tabulating Machine Co., Ltd., intended to form a new company the issued capital of which would be held equally by themselves, in order to implement their policy of collaboration in the design of computers and like equipment. The two parent companies now announce that Computer Developments, Ltd., has been formed, with an authorised capital of £10,000. The first directors of the new company will be: Chairman, Mr. H. B. Stammers (representing the British Tabulating Machine Co., Ltd.); deputy chairman, Mr. T. W. Heather (representing the G.E.C.); Col. J. A. Davies, Mr. C. G. Holland-Martin and Mr. C. Mead (British Tabulating Machine Co.); Mr. J. J. Gracie, Mr. O. W. Humphreys and Mr. E. C. H. Organ (G.E.C.). Dr. D. C. Espley (G.E.C.) has been appointed chief executive. From January next Computer Developments, Ltd., will operate from premises at Computer House, 390-394, Kenton Road, Kenton, Middx. Its registered office is at 17, Park Lane, London, W.1.

Steel Convention

A Customer-Founder Convention, organised by the British Steel Founders' Association, was held on 14th November at the Café Royal, London, at which users and makers were able to meet and exchange views.

Commercial Travellers' Benevolent Institution

The annual Court of Governors of the Commercial Travellers' Benevolent Institution will be held at the Berners Hotel, Berners Street, London, W.1, on 28th December.

Mobile Demonstration Caravan

A caravan fitted as a showroom and lounge has begun a tour of United Kingdom ports with the latest Kelvin Hughes marine products. The demonstration room is fitted with a working model of the new Kelvin Hughes type 14 radar. The scanner is mounted on a roof pedestal which can be lowered during road journeys.

In addition, working models of the new echo sounders are fitted and there are sextants and other standard marine navigational equipment.

Works Medical Centre

The new medical centre of the Stanton Ironworks Co., Ltd., was opened on 14th November by Sir George Barnett, Chief Inspector of Factories.

Saving Fuel Oil

The Federation of British Industries has issued a pamphlet (compiled in co-operation with the National Industrial Fuel Efficiency Service) in which hints are given for saving fuel oil during the present period of restricted supplies.

Diary

Again British Insulated Callender's Cables, Ltd., have produced a desk diary containing a photograph for each week of the year. Most of these are beautiful pictures of English sights and scenery but there are a few relating to the activities of the company and its associates.

Trade Announcements

Philips Electrical, Ltd., announces that its ELA (Electro-Acoustic) Division has been merged with the Musical Equipment Department. The latter will in future be responsible, within the framework of the company's T.V. and Radio Division, for the marketing, etc., of all ELA products. The new organisational policy does not affect the Musical Equipment side of the department which will continue to handle record playing and high fidelity equipment, domestic tape recorders and loose loudspeakers.

Northern area offices have been opened by **Square D, Ltd.,** at 4, Minshull Street, Manchester, 1 (telephone: Central 9757). Mr. W. A. King-Smith, who joined Square D at its inception, has been appointed northern area manager, and he will be assisted by Mr. C. Robinson, who is the new field engineer.

Hoover, Ltd., has opened a Scottish sales-service headquarters at 23, Park Circus, Glasgow, C.3 (telephone: Douglas 7421-7425).

An electronic division has been formed by the **West London Iron & Wire Works, Ltd.,** Osborne Road, Acton, London, W.3, to act as consultants, and to undertake the design development and complete manufacture, including chassis, wiring and installation of prototypes and small batch production of instruments for the radio and electronics industry.

Courtney, Pope (Electrical), Ltd., inform us that the address of their new Manchester office, reference to which was made in our 9th November issue, is 8, Chatham Street and not 18, Chatham Street as stated.

GENERATION AND DEVELOPMENT

Higher Output and Sales

In October the rise in electricity output was at about the same rate as the average increase so far this year. As will be seen from Table 1, 7,657 million kWh was generated by the C.E.A., the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board as compared with 7,022 million kWh in October, 1955, an increase of 9·1 per cent.

Figures given for industrial generation show that in the four weeks ended 27th October the industries covered by the Ministry's return (these do not include railways, transport undertakings, coal mines, gasworks and petroleum refineries) produced 786·3 million kWh, an increase of 1·3 per cent over the corresponding period of 1955. So far this year the industries concerned have generated 7,926·5 million kWh (against 7,808·1 million), an increase of 1·5 per cent.

The sales of the twelve Electricity Boards in October are set out in Table 2 below, together with the totals for the twelve months. The national figures show an increase over October, 1955, of 9·4 per cent, but when corrected for weather conditions and working days the increase is 7·5 per cent.

New Generating Plant

For the second consecutive month a substantial addition to generating plant capacity is recorded in the customary Ministry of Fuel and Power statement. The October net increase of 198 MW (Central Electricity Authority 120 MW, South of Scotland Electricity Board 60 MW and North of Scotland Hydro-Electric Board 18 MW) makes the total for the two months 380 MW. Since the beginning of the year there has been a net gain of 928 MW. New plant installed last month in C.E.A. stations included turbo-alternators at Meaford "B" (60 MW B.T.H.), East Yelland (30 MW C. A. Parsons) and Northampton (20 MW Brush) and boilers at Hams Hall "C" (550,000 lb/hr Simon-Carves), Acton Lane "B" (240,000 lb/hr Mitchell), Ocker Hill "A" (180,000 lb/hr Babcock & Wilcox) and East Yelland (180,000 lb/hr John Thompson).

Profit from Trolley-buses

During the past financial year the South Shields Corporation trolley-buses made a net profit of £5,410, but there was a deficit of £6,204 on the motor-buses, making a deficit of £794 for the undertaking as a whole. There was a surplus of more than £14,000 for the previous year.

Agriculture and Rural Electrification

The first of a series of meetings between staff of the Eastern Electricity Board and the eastern province of the Ministry of Agriculture, Fisheries and Food to discuss the influence of agriculture on rural electrification was held at Electric House, Ipswich, recently. Addresses were given by members of the staff of both organisations and mutual problems were discussed. It is intended that this meeting shall be followed by others in different parts of the province.

TABLE 1.—ELECTRICITY GENERATED AND PLANT INSTALLED

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	3,888	59	32·9	7,016	11	7,037	6,607	21,542
North of Scotland H.E.B. ...	22	—	1·1	35	117	156	154	795
South of Scotland E.B.	235	5	0·1	432	31	464	441	1,278
Total for October, 1956	4,145	64	34·1	7,483	159	*7,657	7,202	23,615
Corres. total for October, 1955 ...	3,660	66	15·0	6,929	78	7,022	6,598	21,600
Inc. or dec., per cent	+13·3	− 3·4	+126·8	+ 8·0	+103·0	+ 9·1	+ 9·2	+ 9·3
Total to date (10 months), 1956 ...	36,336	747	328·8	69,066	1,224	70,428	66,164	—
Total for corres. 10 months of 1955	33,743	857	176·5	63,428	903	64,465	60,569	—
Inc. or dec., per cent	+ 7·7	−12·8	+86·3	+ 8·9	+35·6	+ 9·2	+ 9·2	—

* The total figure includes generation by other methods amounting to 15 million kWh.

TABLE 2.—ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for October (million kWh)			Twelve Months Totals Ended 31st October (million kWh)		
	1955	1956	Inc. or Dec. %	1955	1956	Inc. or Dec. %
London	576·1	610·9	+ 6·0	6,423·2	6,952·0	+ 8·2
South Eastern	356·9	389·5	+ 9·2	3,912·0	4,428·9	+13·2
Southern	423·8	483·3	+14·0	4,724·8	5,337·8	+13·0
South Western	216·1	240·5	+11·3	2,436·4	2,736·9	+12·3
Eastern	562·6	631·9	+12·3	6,310·9	7,036·4	+11·5
East Midlands*	489·6	540·6	+10·4	5,528·4	6,010·0	+ 8·7
Midlands*	641·0	688·2	+ 7·4	7,298·4	7,761·0	+ 6·3
South Wales*	379·4	403·5	+ 6·4	4,240·0	4,496·6	+ 6·1
Merseyside and North Wales* ...	382·5	419·6	+ 9·7	4,334·3	4,737·6	+ 9·3
Yorkshire*	638·5	703·0	+10·1	7,173·0	7,797·8	+ 8·7
North Eastern*	367·2	409·8	+11·6	4,143·7	4,476·6	+ 8·0
North Western*	678·8	724·1	+ 6·7	7,745·8	8,236·6	+ 6·3
Total all Area Boards	5,712·5	6,244·9	+ 9·3	64,270·9	70,008·2	+ 8·9
Direct Supplies by Central Authority	169·8	188·9	+11·2	1,825·0	2,133·5	+16·9
Grand Total	5,882·2	6,433·8	+ 9·4	66,095·9	72,141·7	+ 9·1
Mainly Industrial Areas*	3,577·0	3,888·8	+ 8·7	40,463·6	43,516·2	+ 7·5
Mainly Non-Industrial Areas ...	2,135·5	2,356·1	+10·3	23,807·3	26,492·0	+11·3

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

OVERSEAS

Ceylon Hydro-Electric Finance

Our Colombo correspondent informs us that Ceylon has applied for a loan of Rs.100 million (£7·5 million) from the World Bank to cover the foreign exchange costs of Stage IIB of the Laxapana scheme. The cost of the entire scheme is estimated at Rs.155 million (£11,625,000). The World Bank authorities are reported to have been favourably disposed towards granting Ceylon the loan. Earlier the Bank granted Ceylon a loan of Rs.91 million (£6,825,000) to finance Stage IIA of the scheme.

As soon as the loan is obtained the Government will call for world-wide tenders for the construction work. Work on Stage IIB is expected to commence before work on Stage IIA is completed in 1958.

Atomic Power in South Africa

Our Cape Town correspondent reports that the South African Government has accepted a recommendation by the Atomic Energy Board that a commission should be appointed to inquire into the use of atomic energy in South Africa with particular reference to the erection of a reactor in the Western Cape.

If a decision is taken to erect an atomic power station in Cape Town the overriding consideration will be the

relief that would be given to the country's transport system. Another reason for such a project would be that it would help to prevent South African nuclear scientists being attracted to positions overseas. The findings of the South African mission which went overseas in 1954 to study the development of atomic power for peaceful purposes make it clear that, because of the low price of coal in South Africa, electricity can be developed more cheaply from coal than by atomic power, even in a place like Cape Town. Coal costs only 10s a ton at the Transvaal mines and 42s a ton at Cape Town, including the cost of rail transport. Electricity generated from coal on the Witwatersrand is produced at about 0·35d/kWh.

Power Position in New Zealand

Power rationing in New Zealand is unlikely to be lifted for some time to come. The Bay of Islands Power Board recently appealed to the public to save power "and allow us to keep within our allocation of units from the State Hydro-Electric Department," adding that prospects for 1957 looked worse than those for the current year. Indeed, it is freely stated that the position in 1958 will be worse still. The public is now to be told that every new consumer in New Zealand must be supplied with power from savings by existing consumers.

The Minister in Charge of the State Hydro-Electric Department, Mr. Goosman, says that the time is opportune to expand the combined committee on electricity supply so as to take the question of future electric power supply in the South Island also into consideration. Referring to the project for a power cable across the Cook Strait to link the two islands, the general manager of the State Hydro-Electric Department, Mr. A. E. Davenport, said recently that this would not take power to the North Island to the detriment of the South Island. North Island power stations in the South must be in addition to the South Island's own needs. Consequently, when the building of the 300,000 kW Benmore project was commenced to help supply the North Island's needs, a similar station would have to be started simultaneously, or very soon afterwards, to supply the South Island. The idea of having power cables across Cook Strait was to use the South Island's large hydro-electric resources to fill the needs of both islands—"we stop building in the North and build in the South."

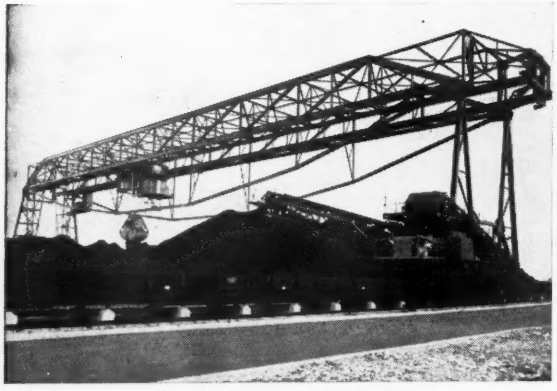
The two islands were hydrologically complementary since the water run-off in the North Island was in the winter and that of the South Island in the spring and summer. The linking of the islands would mean better utilisation of the available resources.

The New Zealand Electrical Supply Authorities' Association is being asked to press for a Royal Commission of Inquiry into the present organisation responsible for providing power stations and for power generation. In support, it is urged that there is need for a competent over-riding authority divorced from political control to plan power needs far ahead, to obtain Parliamentary sanction for its programme and to take full responsibility for doing the work as it is required.

Large Coal Transporter

A travelling transporter, now in full operation at the Central Electricity Authority's new power station at Tilbury, is claimed to be the largest in the country. The transporter, which was designed and built by Mitchell Engineering, Ltd., to the order of Messrs. Merz & McLellan, consulting engineers to the C.E.A., can spread and reclaim coal from the store at an average rate of 800 tons per hour. The normal average depth of coal in the store is about 20ft, giving a storage capacity of about 165,000 tons.

The transporter bridge, operating on tracks 275ft apart, has a travelling speed of 32½ft/min. It is equipped with a man-operated transporter carriage having a cross speed of 700ft/min and is fitted with a 9-ton capacity grab with a hoisting speed of 150ft/min. Thruster-operated clamping gear to hold the bridge securely in position is automatically operated and is applied immediately current is cut off from the travelling motors.



Travelling transporter with 9-ton capacity grab at Tilbury power station

Association of Electrical Machinery Trades

There were over 300 members and friends at the annual dinner and dance of the Association of Electrical Machinery Trades, which was held on Friday last, at the Savoy Hotel, London. Mr. A. H. Spindler, chairman of the Association, who was accompanied by Mrs. Spindler, presided. This function was the ladies' evening and the only toast therefore (apart from the loyal toast) was to the guests, which was proposed by the chairman.

Mr. Spindler, in welcoming the friends of the Association and the ladies, specially mentioned Mr. A. V. Milton (president of the Electrical Contractors' Association), Mr. L. C. Penwill (director, E.C.A.) and Mr. H. E. Jones (secretary, British Association of Machine Tool Merchants). He particularly welcomed the Earl of Verulam (chairman of Enfield Rolling Mills, Ltd.) and referred to his many interests in the industry and in the civic affairs of St. Albans (of which he is Mayor).

The Earl of Verulam, in responding, thanked the Association for its hospitality and in an amusing speech compared its informality with the more austere form of welcome accorded him during a visit he paid to Russia to sign a large cable contract. He spoke of the value to the electrical industry of the work carried out by the Association's members and commended its scheme for training apprentices. Mr. J. Morgan (secretary of the Association), as is customary at this function, added his quota to the evening in a brief and amusing speech, and then the company settled down to enjoy an evening of dancing which included an excellent dance cabaret by Wilby Lunn's "Cavalcade" cabaret, in the course of which some "assistance" was given by members of the Association.

SHUNTING CONTROL

At Feltham marshalling yard on the Southern Region of the British Railways radio telephone communication has been introduced, which enables the pointsmen at the signal boxes which control the movement of wagons to communicate directly with the drivers of the diesel shunting locomotives engaged in propelling the wagons. This new means of communication will speed up marshalling operations, particularly in fog and bad visibility. The installation consists of two fixed stations operating on different frequencies which connect with the mobile station fitted to each of the diesel locomotives. The equipment on the locomotives is provided with switching facilities to enable the receiving sets to be tuned to either signal box before the commencement of shunting operations.

NEW ELECTRICAL EQUIPMENT

Sub-Miniature Capacitors

A range of all-aluminium sub-miniature electrolytic capacitors, which includes the smallest type in existence, has just been introduced by the PLESSEY CO., LTD., Ilford, Essex. The new components will be available for all circuits where small physical size is essential, the smallest capacitor being only 0·1in in diameter and $\frac{7}{16}$in long, including spigots. The range of capacitance is from 1 to 50 μF and for operation at peak working voltages from 1·5 to 70 V. They can be supplied in four case sizes and are suitable for use in the temperature range −15 to +60 deg C, at working voltages up to 40 V d.c., and from −30 to +60 deg C at higher working voltages.

"Terylene" Insulation for Cables

For all types of low voltage applications SIEMENS BROTHERS & CO., LTD., 38-39, Upper Thames Street, London, E.C.4, are now introducing a range of cables insulated with varnished "Terylene." This insulant is based upon the I.C.I. synthetic fibre polyethylene terephthalate and is distinguished for its extremely good non-hygroscopic qualities, its great mechanical strength, and ability continuously to withstand conductor temperatures as high as 130 deg C. A greater cable current rating than that of similar varnished cambric or impregnated paper insulated cables is claimed.

Simulating Guided Missile Temperatures

A precision controlled electric oven by A.E.W., LTD., Imperial Works, High Street, Edgware, Middlesex, has been developed to simulate the rapid rise of temperature attained by guided missiles in high speed flight. The requirements were that the temperature of the air inside the oven should rise at a steady rate of 12 deg C/min up to 150 deg C and be held at any predetermined value within ±1 deg C, a small temperature overshoot on first reaching this temperature being allowable. The rapid rate of rise in temperature was achieved by constructing the oven interior of material having a low rate of thermal absorption, and fitting two impeller fans to obtain a high rate of heat transference from the heating elements.

The rate of climb and temperature control is maintained by a programme controller with averaging bulb, a cam being cut for the heating cycle required. Two electrical contacts follow this cam separated by a predetermined amount on the temperature scale. On switching on, both contacts are made. This supplies the power required for the rate of climb. When the controller approaches the point of control the first contact breaks and the second supplies the power required to maintain the temperature. On reaching temperature the second contact breaks, thus cutting off all power input.

In both cases the power input is only slightly in excess of requirements, being infinitely adjustable for rate of climb required, and for point of temperature control. Both controls are pre-set before switching on and no further attention is required to the oven during the operating cycle. It is also possible to maintain a cooling rate at least equal to that of the rate of climb.

Cargo Cluster Lighting Fitting

A new type of lighting unit for building sites, dockyards, stores and all applications where rough use is likely is announced by the BRITISH CENTRAL ELECTRICAL CO., LTD., 6-8, Rosebery Avenue, London, E.C.1. The guard and suspension ring are of mild-steel wire coated with polythene, and it is hinged at the bottom for easy lamp insertion. The unbreakable white Alkathene reflector is washable, corrosion resistant, and has a high reflection factor.

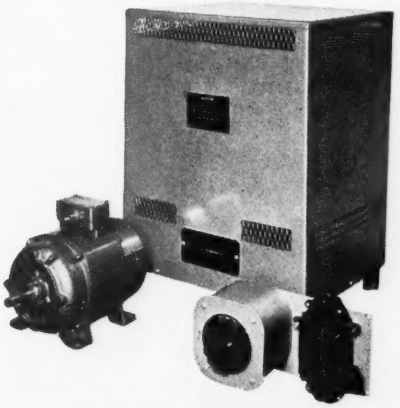
The lampholder is of nylon and its contacts are of the solid end type. The springs, being mounted behind the contacts, do not carry current, making the holder suitable for l.v. use. A unique form of flex lock prevents any strain being transmitted to the lampholder when used with t.r.s. flexible cable. The lighting unit, without lamp or flex, is priced at 20s (b.c. holder) or 20s 6d (e.s. holder).

General Purpose Relay

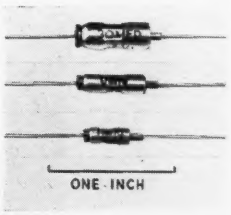
To meet the demand for an "off the shelf" relay for emergency work or replacement purposes LONDEX, LTD., Anerley Works, 207, Anerley Road, London, S.E.20, are making available a general purpose relay which can be purchased from stock. This type MOL relay is of moulded construction with screw type terminals and is equipped with two sets of 6 mm changeover contacts with a rating of 5 A at 250 V a.c. The coil voltage is 200/250 V 50 c/s.

Variable Speed Drives

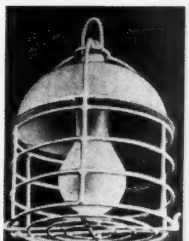
A simple and economic range of adjustable speed drives is announced by LANCASHIRE DYNAMO NEVELIN, LTD., Hurst Green, Oxted, Surrey. Known as the "Varimag," the drives are at present available in ½, 1, 2 and 2½ h.p. sizes, to provide a stepless speed range between 100 and 2,000 r.p.m. The drive consists of a magnetic amplifier circuit designed to supply the armature and field of a d.c. motor. Speed control is obtained manually or automatically from a separately mounted potentiometer. There are no valves or moving parts in the control equipment.



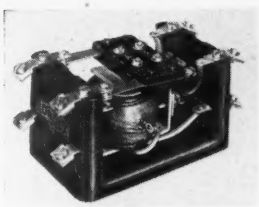
"Varimag" variable speed drive



Plessey sub-miniature capacitors



B.C.E. Co.'s cargo cluster lighting fitting



Londex general purpose relay

Financial Section

STOCKS and SHARES

INCLEMENT market conditions have not prevented a resumption of new issue activity on a substantial scale. Neither have they confined such operations to the issue of the high-yielding type of debenture, loan and other fixed-interest stock which has lately gained in popularity. Within the past week or so the variety of means adopted by industrial firms for the raising of new capital has included proposals for a 5¾ per cent debenture stock from British Oxygen; for a 6 per cent loan stock (convertible into ordinary) from Morphy-Richards; and for large offers of ordinary shares from C. A. Parsons and A. Reyrolle. More than £10 million new money is involved in these four operations alone.

Parsons and Reyrolle

Some £11 million new capital is to be raised by the issues of ordinary shares proposed by C. A. Parsons and A. Reyrolle. In the case of the former company the intention is to offer shareholders 3·6 million shares at a price of 30s on a one-for-one basis. A 50 per cent scrip issue is to be made concurrently. A. Reyrolle shareholders are to be offered 1·53 million shares at 70s each, in the proportion of one new for every two shares held: this company would need something over £2 million in order to exercise the subscription rights attached to its substantial holding of C. A. Parsons shares. On first news of the issues, Parsons shares recoiled from 88s to 80s, and Reyrolle from 98s 6d to 91s. There were quick rebounds, however, to 86s 3d and 96s 3d respectively on second thoughts about the implications of the operation. Meetings in connection with the increases in capital are called for 18th December.

Lucas Results

It had been taken for granted that the difficulties of the motor industry would be reflected in this year's results from Joseph Lucas (Industries), so that there was no adverse market reaction to the disclosure of a 28 per cent drop in the group's trading surplus for the twelve months ended in July. Some of the car manufacturers have lately reported contractions of a much larger order. After taxation, the profit enables the company comfortably to maintain the dividend at the previous total of 7½ per cent. Thanks to the conservative policy in which the board persisted during recent more profitable years, the distribution appears still to be covered well over three times by the earnings available. The £1 shares have been quoted a little higher at 29s 3d ex-dividend, showing a yield of 5·1 per cent.

Market Conditions

As can be seen from the accompanying lists, prices of industrial shares have continued to lose ground. There has again been very little evidence of pressure to sell good investments on any large scale. At the same time, few people are inclined to take on fresh commitments in circumstances like these, with the result that small opposi-

Price Changes in

Company or Board	Nom. Value	Middle price 19th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	73½		3	3	4 1 9	80½	73½
Brit. Elec. 1974/77	100	72½		3	3	4 2 9	79⅛	71½
Brit. Elec. 1976/79	100	75½	−1	3½	3½	4 12 9	84	75½
Brit. Elec. 1974/79	100	86½		4¼	4¼	4 18 3	95	86½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	19/-
East African Power	£1	20/-		7	7	7 0 0	21/3	19/6
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	15/-		10	10*	13 6 9	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/-	−6d	17½	17½	7 19 0	13/6	10/6
Aerialite	1/-	5/3xd		45	48	9 2 9	6/9	4/9
Allen, W. H.	£1	36/3	−1/9	20	10*	5 10 3	39/-	33/6
Aron Elec. Ord.	£1	55/-		15	15	5 9 0	56/-	53/6
Assd. Automation	10/-	15/-	−1/6	10	5	3 6 9	19/-	15/-
Assoc. Elec. Ord.	£1	60/-	−2/6	14	15	5 0 0	85/6	57/9
Automatic Tel. & El.	£1	50/-	−2/6	15	15	6 0 0	72/6	50/-
Babcock & Wilcox	£1	73/3	−6d	15	15	4 2 0	85/6	64/-
Baldwin, H. J.	2/-	4/6	−3d	20	20	8 17 9	5/-	3/9
Bakelite	10/-	25/6	−6d	16	16	6 5 6	34/-	25/6
Berry's Electric	5/-	6/-	—	—	10‡	8 6 9	6/6	5/9
British Aluminium	£1	63/9	−4/6	12	12	3 15 3	78/9	40/6
B.I. Callender's	£1	49/6	−1/-	10	12½	5 1 0	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3	−6d	6	6	5 13 0	22/6	20/3
British Tabulating	£1	42/6	−1/3	9	9	4 4 9	51/3	37/3
British Thermostat	5/-	25/-		20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	7/9		30	15*	9 13 6	8/9	6/-
Brook Motors	10/-	33/9	−1/3	20	25	7 8 3	44/-	31/9
Brush Group	5/-	4/6	−3d	10	10	11 2 3	7/9	4/6
Bulgin, A. F.	1/-	4/6	−3d	45	50	—	5/3	4/3
Burco Dean	5/-	8/9	−6d	—	22½	12 17 3	13/6	8/3
Chloride El. Storage "A"	£1	58/9	−2/6	17½	17½	5 19 3	73/6	58/9
Clarke Chapman	£1	117/6	+2/6	20	22½	3 16 6	123/-	89/6
Cole, E. K.	5/-	15/9	−3d	17½	17½	5 11 0	22/3	15/6
Cossor, A. C.	5/-	6/-		15	Nil	Nil	10/3	5/-
Crabtree	10/-	24/-xd		20	20	8 6 9	29/3	24/-
Crompton Parkinson Ord.	5/-	13/3		16	16	6 0 9	15/-	12/3
De La Rue	5/-	15/3	−6d	30	30	9 16 9	20/3	15/-
Decca "A"	4/-	26/3	+6d	56¼	43¾*	6 13 3	44/9	24/9
Desoutter	5/-	30/6	−6d	25	30	4 18 3	32/9	25/9
Dewhurst	2/-	6/-		24	30	—	7/6	5/3
Dictograph Tel.	2/-	6/9xd		20	20	5 18 6	7/3	5/6
Dubilier Condenser	1/-	5/-	−3d	25	30	6 0 0	5/3	3/6
Duport	5/-	18/-	−6d	23	25‡	6 19 0	21/6	13/9
E.M.I.	10/-	24/6	−6d	15	15	6 2 6	37/-	24/6
Electrical Components	5/-	7/-		25	25	8 18 6*	8/-	6/3
Elec. Construction	£1	23/9		8½	8½	7 2 3	29/9	23/9
Elliott Bros.	5/-	23/9xd		17½	20‡	4 4 3	36/9	23/9
Enfield Cable Ord.	£1	14/-	−1/-	Nil	Nil	Nil	19/3	13/6
English Electric	£1	46/3	−1/3	12½	12½	5 8 0	66/3	45/-
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	31/6	−2/6	20†	20†	3 3 6†	42/9	31/6
Ever Ready	5/-	28/-	−9d	35	35	6 5 0	32/9	24/-
Falk Stadelmann	£1	37/3	−9d	17½	17½	9 8 0	45/9	36/9
G.E.C. Ord.	£1	42/6	−1/3	12½	14	6 11 9	65/6	42/6
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/3	−6d	30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	20/9	−6d	25	30	7 4 6	24/6	18/9
Hackbridge & Hewittic	5/-	17/6		30	23*	6 11 6	22/-	17/3
Heatrae	2/-	4/-	+3d	15	15	7 10 0	5/1	3/9
Henley's	10/-	14/9		10½	11½	7 16 0	19/9	14/-
Holophane	5/-	18/6	−1/3	30	30	8 2 3	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

tion is presented to the routine liquidation of securities. A wait-and-see attitude has reduced activity to a minimum. Industrial markets have been getting little assistance from the gilt-edged section, in which War Loan has lately touched the lowest price recorded in its present form. On the average, industrial share prices are now at approximately the same levels as those ruling two years ago, having lost some 8 per cent of their value since the beginning of the Suez trouble in July.

Electrical Investments

Company or Board	Nom. Value	Middle price 19th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield £ s d	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	23/6		70	50	10 12 9	39/3	23/-
I.C.I.	£1	38/9	−1/-	10	10	5 3 3	49/9	38/9
Intl. Combustion	5/-	18/9		25	20*	5 6 9	25/-	15/3
Johnson & Phillips	£1	30/-xd	−6/6	15	15	10 0 0	46/6	30/-
Lancashire Dynamo	£1	40/-		15	11*	5 10 0	49/9	40/-
Laurence, Scott	5/-	14/9	−6d	12½	15	5 1 9	16/9	13/3
Lister, R. A.	£1	26/9	−6d	9·3	10	7 9 6	35/3	26/9
London Elec. Wire	£1	44/6	−6d	12½	12½	5 12 3	52/9	43/9
Lucas, J.	£1	29/3xd	+3d	7½	7½	5 2 6	40/3	29/3
Marryat & Scott	2/-	9/6		30	30	6 6 3	11/3	9/6
Mather & Platt	£1	52/-	−1/6	15	15	5 15 6	65/3	51/6
Metal Industries	£1	23/9	−9d	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	11/-xc		50	50	—	13/9	10/-
Murex	£1	65/-	−2/6	20	20	6 3 0	74/6	60/-
Newman Ind.	2/-	2/3	−3d	10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/-	−3d	14	12	10 0 0	9/6	5/6
Parsons, C. A.	£1	86/3	−3/9	10	10	2 6 3	96/-	61/6
Plessey	10/-	63/-	−2/6	27½	30	4 15 3	87/6	56/-
Pye " A " Deferred	5/-	14/6	−1/3	12½	12½	4 6 3	21/3	14/-
Reyrolle	£1	96/3	−3/9	15	16½	3 7 6	117/6	81/-
Rheostatic	4/-	9/9		18½	12†	4 19 0	—	8/3
Richardsons Westgarth	5/-	15/6		16⅝	16⅝	5 7 6	17/-	13/9
Scottish Cables	4/-	14/9	−6d	27½	27½	7 9 3	17/9	14/9
Smith (England), S.	4/-	11/-		17½	17½	6 7 3	14/3	10/6
Southern Areas	£1	13/9	−1/3	10	7½	10 18 3	28/9	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/6	6/9
Sturtevant	5/-	22/6		14·4†	15†	3 6 9†	31/3	22/6
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	12/9	−3d	20	25	9 16 0	17/-	12/9
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	36/3		25	25	6 18 6	45/-	36/3
T.C. & M.	£1	25/9	−6d	8½	8½	6 12 0	34/-	25/9
Telephone Mfg.	5/-	6/3xd	−6d	10	10*	8 0 0	8/6	6/3
Thorn Elec.	5/-	16/9	−9d	15	15	4 9 6	22/6	16/-
Thornycroft	£1	33/9xd	−3d	15	12½	7 8 3	49/9	33/9
Tube Investments	£1	53/9xd	−1/6	22½	15*‡	5 11 6	70/6	53/9
Vactric	5/-	11/6	−6d	15	17½*	7 12 3	15/-	11/-
Veritys	5/-	8/6		12½	12½	7 7 0	10/-	6/9
Walsall Conduits	4/-	11/9	−6d	70	20*	6 16 3	13/6	10/9
Ward & Goldstone	5/-	36/3	−1/3	30	35	4 16 6	39/6	29/-
Watford	2/-	5/6	−3d	25	25	9 1 9	7/6	5/6
Westinghouse	£1	70/-	−1/3	18	18	5 2 9	100/-	70/-
West, Allen	5/-	11/9	−3d	15	15	6 7 9	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/9		8	8	7 7 3	23/6	20/3
British Elec. Traction: Def. Ord. " A "	5/-	16/-xd	−1/3	22½	22½	7 0 9	20/-	15/6
Cable & Wireless: Ord.	5/-	9/6xd	−3d	10	10	5 5 3	11/3	9/6
4% Loan	100	91		4	4	4 8 0	92½	88
Calcutta Trams	£1	26/3	−6d	6†	7½†	5 14 3†	27/6	23/-
Cape Elec. Trams	£1	16/3		8	8	9 17 0	20/3	16/3
Marconi Marine	£1	31/-		10	10	6 9 0	34/-	31/-
Oriental Tel. Ord.	1/-	68/9	−1/3	16	—	—	90/-	67/6
Telephone Rentals	5/-	10/3	−6d	12½	12½	6 2 0	11/9	9/9

Interim Dividends

A 7½ per cent interim dividend declared by Simon-Carves applies to ordinary capital increased from £525,000 to £1,500,000 since last year's corresponding payment of 11¼ per cent. In the interval there have been two scrip distributions and a cash issue of shares. In their announcement the company, who are associated with G.E.C. in atomic energy development, advise shareholders that this interim should not be read as implying a total larger than last year's, which was equivalent to 16⅔ per cent on present capital. On that basis the 5s shares at 23s 6d show a yield of about 3½ per cent. Johnson & Phillips £1 shares were marked down to 30s ex-dividend after news that, in the light of trading results in the first eight months of the year, the interim dividend is being reduced from 7½ to 5 per cent. The statement added that orders recently received show a definite improvement.

Company News

Profits of S. Smith & Sons (England) declined during the year ended last August, but to an extent considerably more moderate than the market had been prepared to see, considering the difficult conditions prevailing for some sides of the group's interests during the period. After a smaller tax charge, the net profit of £1·16 million is 14 per cent under the previous figure. Ordinary dividends, which are brought up again to a total of 17½ per cent, cost £290,000 so that practically three-quarters of the net earnings remain to go back into the business. After the news the price of the 4s shares was firm at 11s, at which the yield is close on 6½ per cent. Brook Motors 10s shares were lowered to 31s in the market (the official quotation was 33s 9d) after the announcement of the annual results. Earnings have fallen, but the dividend is maintained at a total of 25 per cent, as forecast at the time of this year's issue of new shares, which rank for the final dividend now declared.

Miscellaneous Notes

Another reference to capital issue intentions is contained in the full Tube Investments report. Since the substantial issue of ordinary shares a year ago the group has made fresh acquisitions which, together with the cost of the development plans in hand, will call for more new capital. This will probably be raised next year. The British Oxygen issue takes the form of £10 million 5¾ per cent debenture stock 1981/86, to be offered publicly at 98. Application lists open to-day, Friday. Veritys 5s shares have been quoted at about 8s 10½d, and Limit Engineering 1s shares at 2s 6d, since the latest circular to Veritys' shareholders in connection with the Limit offer of a share exchange in the proportion of four Limit for one Veritys share.

REPORTS and DIVIDENDS

Crompton Parkinson, Ltd.—The main figures in the accounts for the year ended 30th June last were given in the preliminary statement in our issue of 2nd November. With the report and accounts now issued, Mr. Albert Parkinson (chairman) has circulated his review of the group's activities during the year.

He says that it has been another year of active development overseas. With regard to Noyes (Australia) Pty., Ltd., the selling and merchanting company which covers Australia and in which Crompton Parkinson owns a 50 per cent interest, as a result of the uniting of various interests certain organisational changes have been completed and the task of consolidating its component parts is making satisfactory progress. In consequence of the action by the Commonwealth Government to combat inflation, trading conditions in Australia are not easy and the joint selling company is not yet able to reap the full rewards of its reorganisation. Expansion of their manufacturing facilities in Australia is proceeding and at Campbelltown their 250-acre site is now in its first stage of development. In India they are extending their range of manufacture, particularly in the field of switchgear. Plans have been prepared and submitted for Indian Government approval which provide for a substantial increase in their Indian manufacturing facilities. In South Africa since 1952 they have, in equal partnership with Lancashire Dynamo Holdings, Ltd., operated a small factory for the manufacture of a.c. motors. This enterprise has proved to be an uneconomic proposition, and in agreement with their partners, they have closed the factory and disposed of the greater part of its equipment. Their South African selling company will revert, as far as possible, to the practice of drawing its requirements from the factories in the United Kingdom.

In Canada, the new switchgear factory at Brantford, Ontario, has commenced production and is rapidly expanding its output to satisfy a full order book. The Canadian products will be sold through the associated company, Bepco Canada, Ltd.

Turning to home developments, Mr. Parkinson says that the extension to the central development and research laboratories has now been completed and is in use. They have committed themselves to a substantial programme of expansion and improvement at home. This has as its principal objective the increase of their manufacturing capacity and the improvement of their productive efficiency. Major extensions and reconstruction work have been carried out at the transformer works at Hayes which will enable them to meet any demand for transformers of the largest capacity and highest voltage. Expansion at the Southall works of L. Clarke & Co., Ltd., has now been completed and has resulted in a production area almost double that which was available when they acquired the company. Extensions have been commenced at the works at Chelmsford, Doncaster and Derby covering the production of switchgear, traction equipment, lighting fittings, and cable.

In the electric traction field they are particularly heavily committed and expect to be engaged to their full capacity for several years to come. As sub-contractors for the supply of electric traction equipment for the British Railways modernisation scheme their traction division has received substantial orders. Austin Crompton Parkinson Electric Vehicles, Ltd., and I.T.D., Ltd., owned jointly with the Austin Motor Co., Ltd., have had another successful year.

Tube Investments, Ltd. — The annual meeting will be held on 10th December. In his statement circulated to shareholders, Sir Ivan A. R. Stedeford (chairman) says that during the year under review there was an increase in turnover of over £22 million, with all divisions but the cycle division exceeding their previous year's performance. An increase of nearly 15 per cent in the sales of the electrical division, in what proved to be a contracting home market in domestic appliances, was a significant and a satisfactory feature of the year's results. The main reasons for this are to be found in the Creda "Carefree" cooker, in the new "Stargazer" cooker and in the Creda water heaters. Their new space heaters are attractive in appearance and effective in performance. Another potential "best-seller" is the Creda "Debonair" spin dryer.

During the year the company has acquired the Power Centre Co., Ltd., with works at Walsall and Wednesbury, specialising in electrical distribution gear, including overhead busbar systems, ironclad switchgear and switchboards, and cable trunking and accessories. Plans are in hand for expanding the manufacturing capacity of this business.

The dispatches overseas were more than 5 per cent up in value over the preceding year; dollar business again took pride of place with the United States still heading the list and sales to Canada increasing by over 30 per cent. Satisfactory results have been reported from all subsidiary and associated companies overseas.

Joseph Lucas (Industries), Ltd.—The group trading surplus for the year to 31st July last amounted to £5,010,441, against £7,078,422 for 1954-55, which with other income makes £5,330,204. Taxation absorbs £3,848,730, and the net balance is £1,519,722 (against £2,207,087), of which £1,282,386 is dealt with in the accounts of the parent company. The ordinary dividend for the year is maintained at 7½ per cent by a final payment of 5 per cent.

Morphy-Richards, Ltd.—The annual meeting was held on 14th November, Mr. H. D. Drysdale (chairman) presiding. The chairman's statement covering the past year had been circulated previously and was abstracted in our issue of 2nd November. At the meeting Mr. Drysdale announced the terms of the issue of £500,000 unsecured convertible loan stock. He said that arrangements had now been completed with Robert Benson, Lonsdale & Co., Ltd., to underwrite the issue which would be offered to holders of ordinary stock at 98½ per cent and would bear interest at the rate of 6 per cent. The stock would carry rights of conversion into ordinary stock (after the bonus issue of three shares for every two held) as follows:—Up to 31st December, 1958, on the basis of one 4s ordinary share for every 11s 3d stock. From 1st January, 1959, to 31st December, 1960, on the basis of one 4s ordinary share for every 12s 6d stock. Stock not converted would be redeemable at par on 30th June, 1972, or at the company's option on or after 1st July, 1967, at 101 per cent. A sinking fund would commence in the year ending 30th June, 1962, calculated to redeem 50 per cent of the stock then outstanding by maturity.

Simon-Carves, Ltd., has declared an interim dividend of 7½ per cent on £1·5 million (against 11¼ per cent on £525,000). The directors state that this must not necessarily be taken as an indication that the total distribution for 1956 will be greater than for 1955 when the rate was equivalent to 16⅔ per cent on the present capital. From the present indications the results for 1956 should be approximately the same as for the previous year.

Yarrow & Co., Ltd., report a group net profit for the year ended 30th June last of £165,493, as compared with £167,844 for 1954-55. This is after deducting £260,000 for taxation. General reserve receives £150,000 and it is proposed to pay an ordinary dividend of 20 per cent for the year (against 17½ per cent). The recent 33⅓ per cent scrip issue does not rank for this payment.

The Plessey Co., Ltd.—The group trading profit for the year ended 30th June last was £1,525,158, as compared with £1,553,018 for 1954-55. Taxation absorbs £841,719, and the net balance is £702,952 (against £808,922). A sum of £350,000 is placed to general reserve and it is proposed to pay a final dividend of 15 per cent, making 30 per

[*Continued on page* 985

FINANCIAL SECTION (*Continued*)

cent for the year on ordinary capital of £1,200,000. For 1954-55 the distribution was 27½ per cent on ordinary capital of £800,000. The balance carried forward is £990,852 (against £873,118 brought in).

Brook Motors, Ltd.—The group profit for the year ended 30th September last is £368,282, as compared with £503,693 for the preceding year. Taxation requires £234,851 and the net balance is £133,431 (against £231,446). It is proposed to pay a final dividend of 20 per cent on £1,441,364 ordinary 10s shares. An interim dividend of 5 per cent was paid on ordinary capital of £1,141,364 before a " rights " issue. For the preceding year the total ordinary distribution was 25 per cent on the smaller capital.

Veritys, Ltd.—Cooper Brothers & Co., accountants, have reported to the company that the offer made by the Limit Engineering Group, Ltd., to acquire the whole of the issued capital of Veritys in exchange for an allotment of four shares of 1s each of the Limit Engineering Group for each 5s stock unit of Veritys is fair and reasonable, and Mr. H. B. T. Wilde (chairman) and three directors of Veritys recommend its acceptance. Two directors, however (Messrs. P. E. C. Merryfield and J. A. Robertson), have asked stockholders to take no action until they hear from the stockholders' committee set up to consider the proposals. This committee has since announced that, on the information at present before it, it does not consider that the offer is one which can be recommended for acceptance. A detailed report of its views is being forwarded to stockholders.

A. Reyrolle & Co., Ltd., and **C. A. Parsons & Co., Ltd.**—These two companies have received the consent of the Capital Issues Committee for the raising of new capital. A. Reyrolle & Co. holds 40 per cent of the equity of C. A. Parsons. The Reyrolle issue is 1,526,470 £1 ordinary shares at 70s each on the basis of one for every two held. The new stock will rank for any further dividend in respect of the current financial year. The proposed new capital of C. A. Parsons involves the issue of 3·6 million £1 ordinary shares at 30s each on a one-for-one basis and a 1·8 million share one-for-two scrip issue. Extraordinary meetings to consider the proposals will be held on 18th December.

The Perak River Hydro-Electric Power Co., Ltd.—The annual meeting was held on 14th November, Mr. H. G. Balfour (chairman) presiding. In the course of his circulated statement, the chairman said that during the year under review 436·1 million kWh was generated, as compared with 432·1 million in the preceding year, and the maximum load rose from 67·4 MW to 68·9 MW. It was reported last year that an order had been placed for a new 12 MW turbo-alternator and ancillary boiler plant for Malim Nawar. This set was due to come into operation in 1958, and in view of the increasing load on the system the directors decided to order a further 12 MW generating set which was due to come into operation in 1959. These two sets were to a certain extent replacement of existing generating capacity which was nearing obsolescence, and consideration would have to be given in the near future to further additions unless substantial bulk supplies became available from the Central Electricity Board.

The British Oxygen Co., Ltd.—The application list opens to-day (Friday) for a public offer by Lazard Brothers & Co., of £10 million in 5¾ per cent debenture stock, 1981-86, at a price of 98. Preferential consideration will be given to members of the company.

Richardsons, Westgarth & Co., Ltd., have declared an interim ordinary dividend of 6⅔ per cent on £2,185,732 capital. A similar interim dividend was paid in the previous year on capital of £1,769,360, before a " rights " issue.

Associated Electrical Industries, Ltd., has declared a third interim dividend of 2½ per cent (unchanged). The new capital of £8·5 million ranks for this dividend.

Efco, Ltd., is paying an interim dividend of 4 per cent (against 2¼ per cent).

Pye (Ireland), Ltd., has announced an interim dividend of 2 per cent (unchanged).

Richard Johnson & Nephew, Ltd., have announced an interim dividend of 3 per cent (unchanged).

Increases of Capital

New Day Electrical Accessories, Ltd.—Increased by £20,000, in £1 ordinary shares, beyond the registered capital of £10,000.

Watsham's, Ltd.—Increased by £50,000, in £1 ordinary shares, beyond the registered capital of £50,000.

Thomas Laurie & Co., Ltd.—Increased by £38,000, in £1 ordinary shares, beyond the registered capital of £12,000.

Bankruptcies

Alexander Mitchell Henry, 14b, Woodgrange Avenue, Ealing Common, London, W.5, electrical heating engineer.—Receiving order made 26th October on a creditor's petition. (Amended notice.)

H. J. Walby, lately carrying on business under the style of Theale Electric, at 86, Hill Rise, Richmond, Surrey, electrical engineer.—Order made 10th October suspending discharge for six months until 10th April, 1957.

K. M. Ashworth and **D. Revell,** trading in co-partnership as Ashworth & Revell, at 265, Bradford Road, Frizinghall, Bradford, and at 120, Otley Road, Shipley, Bradford, electrical contractors.—Trustee, Mr. G. E. Rushton, 36, North Parade, Bradford, 1, released 1st November.

D. E. Pitchers, 89, Gorleston Road, Oulton Broad, Lowestoft, electrician, formerly trading at 13, Tann Lane, Caister-on-Sea, Norfolk, radio and electrical engineer.—Trustee, Mr. F. R. D. Walter, Castle Chambers, Opie Street, Norwich, Official Receiver, released 30th October.

C. Sykes, 10, High Keppleway, Broughton-in-Furness, Lancs, electrician.—Receiving order made 5th November on debtor's own petition. Public examination 12th December at the Magistrates' Court, Lawson Street, Barrow-in-Furness.

E. Bowes, carrying on business at 3, Front Street, Langley Park, Durham, radio and electrical engineer.—Composition scheme under which preferential debts and all proper fees, costs and expenses of and incidental to the bankruptcy proceedings are to be paid out of £450 to be provided by third parties; balance due to creditors to be paid by instalments of £15 a month. Receiving order dated 17th July discharged and adjudication of the same date annulled.

H. Harding, 15c, Mill Lane, Macclesfield, Ches., electrical contractor.—First and final dividend of 4⅞d in the £, payable at the Official Receiver's office, 12, Lonsdale Street, Stoke-on-Trent.

Liquidations

Tiny Tim Lighting & Power Unit, Ltd., electrical appliance dealers.—Winding up voluntarily. Liquidator, Mr. H. E. G. Wright, Portland House, 73, Basinghall Street, London, E.C.2, appointed 30th October. Particulars of claims to the liquidator by 4th December. This notice is purely formal. All known creditors have been, or will be, paid in full.

D. J. Clarke (Biggleswade), Ltd., radio and television dealers.—Winding up voluntarily. Liquidator, Mr. H. Bach, 15, Soho Square, London, W.1, appointed 5th November. Particulars of claims to the liquidator by 30th November.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 30th November:—

SPEEDA-MATIC. No. 755,261. Class 7. Machines for washing, drying and ironing, all for laundering purposes.—Simplex Electric Co., Ltd., Broadwell, Oldbury, near Birmingham.

SUNBEAM. No. 741,701. Class 9. Electrical apparatus and instruments; and scientific, nautical, photographic, cinematographic, optical and weighing apparatus and instruments; and parts and fittings, but not including radio receiving sets or any goods of the same description.—Sunbeam Corporation, Chicago, U.S.A. Address for service, c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, London, W.C.2.

UNICUBE. No. 751,549. Class 9. Electric switchboards and electric switchgear.—M. & C. Switchgear, Ltd., Kelvinside Works, Kirkintilloch, Glasgow.

TELODIAL. No. 755,112. Class 9. Automatic dialling devices for telephones.—Alfred Demeulenaere, Ixelles-Brussels, Belgium. Address for service, c/o Marks & Clerk, 57 & 58, Lincoln's Inn Fields, London, W.C.2.

CELANESE. No. 755,829. Class 9. Scientific apparatus and instruments; and electrical apparatus and instruments.—British Celanese, Ltd., Celanese House, 22-23, Hanover Square, London, W.1.

FLO-LINE. No. 755,840. Class 9. Electric bells and parts.—Gent & Co., Ltd., Faraday Works, Temple Road, Leicester.

EXPAMET. No. 756,425. Class 9. Electric resistors and parts.—Expanded Metal Co., Ltd., Burwood House, Caxton Street, Westminster, London, S.W.1.

MERAD. No. 756,567. MERFLON. No. 756,569. Class 9. Electric cables.—Mersey Cable Works, Ltd., Linacre Lane, Bootle, Liverpool, 20.

CONTEREX. No. 755,482. Class 17. Electrical insulating materials and articles made therefrom.—Connollys (Blackley), Ltd., Blackley, Manchester, 9.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 28th November from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

26812. Staatsbedrijf der Posterijen, Telegrafie en Telefonie.—Automatic telephone and like signalling system. 24th October, 1952. (762273.) 28017. Control of an automatic signalling system. 6th November, 1952. (762274.)

27921. Electric & Musical Industries, Ltd. —Television cameras. 6th November, 1953. (762458.)

31214. General Electric Co., Ltd., and Cates, J.—Electric circuit arrangements for starting and operating from a source of supply a plurality of low pressure electric discharge lamps. 25th January, 1954. (762173.)

32266. General Electric Co., Ltd., Power, E. B., and Rigden, S. A. R.—Electric discharge devices of the type containing at least one electron emissive electrode. 21st December, 1953. (762354.)

1953

1231. Chromatic Television Laboratories, Inc.—Colour selecting means in colour television receivers. 15th January, 1953. (762355.)

9750. Heron Heating Devices, Ltd., and Heron, A. G.—Electric defrosting apparatus for use in refrigerating apparatus. 30th March, 1954. (762576.)

13933. Standard Telephones & Cables, Ltd.—Gas-filled electric discharge tubes. 14th May, 1954. (762579.)

14315. General Electric Co.—Image converters for X-ray and like penetrating radiation. 21st May, 1953. (762178.)

14627. British Thomson-Houston Co., Ltd.—Bayonet-type electrical plug connectors. 1st April, 1954. (762470.)

17394. Trist & Co., Ltd., R.—Control mechanism for electric switches. 23rd June, 1954. (762363.)

18619. Bulpitt & Sons, Ltd.—Electrically heated appliances having thermal cut-outs. 29th June, 1954. (762364.)

20049. Cunningham Son & Co., Inc., J.—Inter-connecting electrical switches. 20th July, 1953. (762366.)

21356. General Electric Co., Ltd., Nelson, E. H., and Rigden, S. A. R.—Electric discharge lamps. 29th July, 1954. (762479.)

23233. United Kingdom Atomic Energy Authority.—Integrating circuits for rate-meters. 24th November, 1954. (762369.)

25853. Siemens Bros. & Co., Ltd.—Electric converting systems. 17th December, 1954. (762486.)

25859. British Thomson-Houston Co., Ltd.—Electrical waveguides. 18th October, 1954. (762373.)

27556. General Electric Co., Ltd., and Cates, J.—Electric circuit arrangements for starting and operating at least one low pressure electric discharge lamp. 5th January, 1955. (762489.)

29684. Metropolitan-Vickers Electrical Co., Ltd.—X-ray generators. 27th October, 1954. (762375.)

30793. Standard Telephones & Cables, Ltd.—Automatic telephone systems. 6th November, 1953. (762587.)

32672. Plessey Co., Ltd.—Holder for supporting scanning coils of cathode-ray tubes. 22nd November, 1954. (762589.)

33174. British Tabulating Machine Co., Ltd.—Electronic measuring apparatus. 22nd October, 1954. (762499.)

34442. Engel & Gibbs, Ltd.—Electromagnetic relays. 12th November, 1954. (762503.)

35851. Brookhirst Switchgear, Ltd., and Morrey, C.—Terminal blocks and terminal boards for electrical installations. 9th December, 1954. (762505.)

1954

456. National Research Development Corporation.—Digital encoders and decoders. 24th December, 1954. (762284.)

916. Griffin & George, Ltd.—Plug and socket electrical connections. 12th January, 1955. (762508.)

3084. General Electric Co., Ltd.—Lighting fittings including support mechanisms for detachable reflectors. 11th March, 1955. (762202.)

3617. Licentia Patent-Verwaltungs Ges.—Electric protective devices for mechanical contact converters. 8th February, 1954. (762511.)

4073. Siemens & General Electric Railway Signal Co., Ltd., and Riddle, H. J. N.—Electrical timing devices. 27th January, 1955. (762384.)

4345. International Business Machines Corporation.—Barrier grid target electrodes for electronic tubes. 15th February, 1954. (762294.)

5720. English Electric Co., Ltd.—Electrical circuits including polarised electromagnetic switches. 25th February, 1955. (762206.)

5787. British Thermostat Co., Ltd.—Electrical heating devices. 25th February, 1955. (762389.)

5797. Hoover, Ltd.—Commutators. 14th February, 1955. (762207.)

6360. Igranic Electric Co., Ltd.—Electronic timing systems. 4th March, 1954. (762208.)

6396. Telegraph Construction & Maintenance Co., Ltd.—Electric cables and protective coverings therefor. 3rd March, 1955. (762209.)

6746. Smith & Sons (England), Ltd., S.—Circuits incorporating semi-conductive devices. 3rd March, 1955. (762516.)

7633. Vanier, G.—Differential electric induction relays. 16th March, 1954. (762517.)

8435. Alden, M.—Electrical indicator lights. 23rd March, 1954. (762392.)

8809. F.K.G.F. Kesselring Gerätebau Akt.-Ges.—Arrangements for interrupting direct or alternating electric currents. 25th March, 1954. (762603.)

9109. East Midlands Electricity Board, and Hutchinson, S.—Electric lighting equipment. 7th March, 1955. (762217.)

10322. Hoover, Ltd.—Floor polishers. 8th April, 1954. (Divided out of 762277.) (762307.)

10858. Soc. d'Eléctronique et d'Automatisme.—Electronic integration systems. 13th April, 1954. (762221.)

11696. Metropolitan-Vickers Electrical Co., Ltd.—Electric control systems. 19th April, 1955. (Addition to 727320.) (762224.)

11832. Mullard Radio Valve Co., Ltd.—Transistor circuit arrangements. 29th March, 1955. (762526.)

14612. Postmaster General.—Electric discharge devices. 10th May, 1955. (762530.)

15430. Hiller, W., and Hiller, M. (trading as Atrax-Hiller Komm.-Ges.).—Fluorescent electric lamp. 25th May, 1954. (762233.)

15835. Standard Telephones & Cables, Ltd.—Multi-aspect light signal for railways. 28th May, 1954. (762407.)

16025. Fielden Electronics, Ltd.—Electrical transducers. 7th April, 1955. (762532.)

17235. Wandel, W., and Goltermann, U. —Method of and circuit arrangement for measuring the phase angle between two electrical oscillations of equal frequency. 11th June, 1954. (762534.)

21854. English Electric Co., Ltd.—Thrust bearing supports for hydro-electric vertical shaft machines. 22nd July, 1955. (762245.)

22344. Schneider, K. A.—Apparatus for the subterraneous laying of cables and other objects. 30th July, 1954. (Addition to 689754.) (762634.)

22721. Cole, Ltd., E. K., and Strachan, P. A.—Rotary electric switches. 25th July, 1953. (762636.)

23097. McGraw Electric Co.—Core for electro-magnetic induction apparatus. 9th August, 1954. (762249.) 23098. Method of making magnetic cores for transformers or the like. 9th August, 1954. (762250.)

23593. Philips Electrical Industries, Ltd. —Electrically-conductive slag forming bodies for use in stud welding. 13th August, 1954. (762252.)

23803. Zeiss Ikon Akt.-Ges.—Projection arc lamps. 16th August, 1954. (762639.)

24029. Standard Telephones & Cables, Ltd.—Hermetically sealed electrical components. 18th August, 1954. (Addition to 634544.) (762640.)

24179. Calor-Emag Elektrizitäts-Akt.-Ges.—Method of and apparatus for the elongation or extinguishing of electric arcs. 19th August, 1954. (762642.)

25651. General Electric Co.—Production of grain oriented silicon steel. 3rd September, 1954. (762543.)

26771. General Electric Co.—Electric circuit interrupters. 15th September, 1954. (762547.)

27000. English Electric Co., Ltd.—Commutators for dynamo-electric machines. 9th September, 1955. (762330.)

28346. Philips Electrical Industries, Ltd. —Dry shaving apparatus. 1st October, 1954. (762438.)

30049. Morle, C. W. (Philco Corporation). —Electron discharge devices. 19th October, 1954. (762550.)

30567. Philips Electrical Industries, Ltd. —Circuits for synchronising an oscillator with received synchronising signals. 22nd October, 1954. (762551.)

31278/9. Sulzer Freres Soc. Anon.—Steam turbine plants. 29th October, 1954. (762555/6.)

32046. Standard Telephones & Cables, Ltd.—Arrangement for preventing the afterglow of the steady luminous spot after the switching-off of television sets employing cathode-ray tubes. 5th November, 1954. (762440.)

34331. Standard Telephones & Cables, Ltd.—Electro-forming of semi-conductive rectifier cells. 26th November, 1954. (761839.)

34616. Allmänna Svenska Elektriska Aktiebolaget.—Control device for speed regulation of motors. 30th November, 1954. (761841.)

35879. Siemens & Halske Akt.-Ges.—Delay lines for travelling wave tubes. 10th December, 1954. (762565.)

35979. Walter, E.—Multi-core electric cables. 13th December, 1954. (762343.)

36135. Westinghouse Air Brake Co.—Polarised electro-magnetic relays. 14th December, 1954. (761747.)

36183. Bendix Aviation Corporation.—Arrangement for cooling a control or like box of a dynamo-electric machine. 14th December, 1954. (761958.)

36318. Philips Electrical Industries, Ltd. —Frequency modulation circuits. 15th December, 1954. (762566.)

36798. Egyesült Izzolampa Es Villa-Mossagi R.T.—Electro-luminescent sources of light. 20th December, 1954. (761961.)

37080. General Electric Co.—Colour television system. 22nd December, 1954. (762060.)

37656. Philips Electrical Industries, Ltd. —Magnetic separators. 30th December, 1954. (762163.)

37701. Elektroprojekt. — Pylons. 30th December, 1954. (761964.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Bilston.—Borough Council. 7th December. Street lighting equipment. Borough engineer, 20, Wellington Road.

Burma.—Union Purchase Board. 4th December. 136 superposing unit transformer switchboards. (E.S.B. 28862/56. Ten/22636.)*

Chorley.—R.D.C. 31st December. Duplicate pumping machinery with switchgear for Coppull waterworks pumping station. Water engineer, Council Offices, Gillibrand Street.

Exeter.—City Council. 17th December. Medium voltage distribution switchgear for Countess Wear sewage works. (See this issue.)

Fishguard and Goodwick.—U.D.C. Street lighting equipment. (See this issue.)

Formosa.—Central Trust of China, Purchasing Department. 11th December. Telephone equipment including automatic switchboards, testing equipment, main distributing frames, tools, etc. 13th December. Telephone cables. (E.S.B. 28668/56.I.C.A. Ten/22631.)* 17th December. Eight 1,500 W generators. (E.S.B. 28664/56.I.C.A. Ten/22628.)*

Greece.—Ministry of Finance. 1st December. Thirteen refrigerators for chemical laboratories. (E.S.B. 28974/56. Ten/22707.)*

Hebburn.—U.D.C. 11th December. Electrical installations in 215 houses at Elmfield Road. Surveyor, Argyle Street.

India.—Director General of Supplies and Disposals. 4th December. Telephone cable. (E.S.B. 28678/56. Ten/22612.)* 7th December. Switchboard cable. (E.S.B. 28679/56. Ten/22613.)*

Corporation of Madras. 10th December. Electrical pumping plant for Royapuram sewage pumping station. (E.S.B. 28658/56. Ten/22605.)*

Government of Travancore-Cochin. 30th January. Water turbines, generators, transformers, switchgear, and remote supervisory control gear for Panniar hydro-electric project. (E.S.B. 28672/56. Ten/22600.)*

Irish Republic.—Co. Clare Vocational Education Committee. 4th December. Electrical installation in the new technical school at Ennistymon. Dowling & Co., architects, 1, Bindon Street, Ennis, Co. Clare.

Kidderminster.—Borough Council. 8th December. Street lighting equipment. (See this issue.)

London.—Wandsworth Borough Council. 14th December. Supply of sodium lamps for the year commencing 1st April, 1957. Borough engineer, Municipal Buildings, Wandsworth, S.W.18.

Merthyr Tydfil.—Borough Council. 15th December. Street lighting equipment. (See this issue.)

New Zealand.—General Post Office. 11th December. Switchboard and instrument cords. (E.S.B. 28622/56. Ten/22570.)* 13th December. Switchboard cable and wire. (E.S.B. 28629/56. Ten/22603.)*

Northern Ireland. — Armagh Education Committee. 11th December. Electrical installation in proposed county intermediate school, Church Road, Portadown. J. R. W. Murland, consulting engineer, 13, Wellington Place, Belfast.

Board of Governors. 30th November. Electrical installation in the new extension to Coleraine Academical Institution. A. W. Gordon Holt, consulting engineer, 74, South Parade, Belfast.

Belfast City Council. 11th January. CO_2 fire fighting equipment for Ormeau and Fortwilliam substations. (See this issue.)

Pakistan.—Posts and Telegraphs Department. 10th December. Telephone plugs, sockets, ringing machines and telephone meters, etc. (E.S.B. 28794/56. Ten/22648.)* 11th December. Electric bells. (E.S.B. 28793/56. Ten/22647.)* 15th December. Galvanometers, G.P.O. detectors, etc. (E.S.B. 28795/56. Ten/22649.)*

Peterborough.—City Council. 30th November. Electrical installations in 36 bungalows and 50 houses, Walton, Bluebell and Crown Street estates. (See this issue.)

Philippines.—National Power Corporation. 6th December. Outdoor switchgear and accessories for Bauang switching substation. (E.S.B. 28955/56. Ten/22698.)*

Rhodesia and Nyasaland. — Southern Rhodesia Electricity Supply Commission. 13th December. Steel cored aluminium conductors and disc insulators. (E.S.B. 28573-4/56. Ten/22578-9.)*

Rochester.—Town Council. 1st December. Street lighting equipment. City surveyor, 66, Maidstone Road.

Sedgley.—U.D.C. 4th December. Street lighting equipment. (See this issue.)

Sittingbourne and Milton.—U.D.C. 11th December. Street lighting equipment. Surveyor, Central Avenue, Sittingbourne, Kent.

South Africa.—Stores Department, South African Railways. 14th December. Telegraph line material including steel and concrete poles. (E.S.B. 28674-6/56. Ten/22558-60.)* Cable and copper wire. (E.S.B. 28693-4/56. Ten/22601-2.)*

Spondon.—Parish Council. 7th December. Street lighting equipment. (See this issue.)

Sudan.—Ministry of Communications, Posts and Telegraphs Department. 1st December. Underground cable. (E.S.B. 28547/56. Ten/22584.)*

Uruguay.—Administracion de Ferrocarriles del Estado. 3rd December. Copper wire. (E.S.B. 28680/56. Ten/22652.)*

Wiltshire.—County Council. 2nd January, 1957. Electrical installation in Amesbury Secondary Modern School. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Acton.—Two-storey additions, Victoria Road; Lowe & Brydone (Printers), Ltd., Victoria Road, London, N.W.10.

Ascot.—Houses (62), Cheapside Road; Halfacre & Young, builders, Holyport Road, Maidenhead.

Basingstoke.—Four-storey shops and offices, Winchester Street; Associated Suburban Properties, Ltd., 38, Upper Grosvenor Street, London, W.1.

Bedale.—Houses (51) for R.D.C.; H. Richardson & Shaw, 3, Skinnergate, Darlington.

Birkenhead.—Dwellings (254), Prenton Dell estate; borough architect.

Blackburn.—New science wing at Queen Elizabeth's Grammar School (£62,000); W. Stirrup and Son, architects, 14, Richmond Terrace, Blackburn.

Cumberland.—Proposed new Houghton C. of E. School; county architect, Portland Square, Carlisle.

Chesterfield.—Houses at Killamarsh (62) and Tupton (25); R.D.C. architect.

Crawley.—Premises (£40,000) for Lloyds Bank, Ltd.; L. Francis & Sons, quantity surveyors, Vernon House, Sicilian Avenue, London, W.C.1.

Croydon.—Houses at New Addington (68), Woodville Road, Thornton Heath (16) and Sonning/Malcolm Roads, Woodside (11); E. Taberner, town clerk, Town Hall.

Dartford.—Maisonnettes and flats (44), Temple Hill; S. G. & A. Agombar, Ltd., builders, 109, Elmers End Road, Beckenham.

Dudley.—Houses (314), Russells Hall estate and houses (73), Woodside redevelopment area; P. D. Wadsworth, town clerk, Council House.

Eastcote.—Flats (72); Hugh C. Duncan, architect, 9, Hertford Street, London, W.1.

Edenthorpe.—Houses (40) in Edengrove Road; C. N. King, Ltd., builders, Doncaster.

Edmonton.—Rebuilding and extensions to departmental stores; F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1.

Ennerdale.—Houses (140), Thornhill; North Eastern Housing Association, Metrovick House, Northumberland Road, Newcastle-on-Tyne.

Felling-on-Tyne. — County secondary school; P. L. Browne, Son & Harding, Pearl Buildings, Newcastle-on-Tyne.

Gateshead.—Houses and bungalows (98) at Easington Avenue; Wimpey & Co., Ltd., Orchard House, Newcastle-on-Tyne.

Houses (78) at Ventnor Gardens; R. G. Tarran & Son, builders, Perth.

Glasgow.—High school for girls, Clevedon Road, Kelvinside (£350,000); J. MacNab, architect, Education Department, Bath Street, C.2.

Gravesend. — Houses (202), Singlewell estate; C. J. Howard, Ltd., builders, 282a, High Street, Chatham.

Great Yarmouth.—Bridge Road Secondary Modern School, Gorleston (£152,284); borough surveyor, 15, Regent Street.

Hambledon.—Houses, Shamley Green (64) and Elstead (12); R. J. Garland, clerk to R.D.C., Council Offices, Bury Fields, Guildford.

Hartlepool.—Houses (90), Dock Street area; borough engineer.

Hebburn.—Houses (77) adjoining Campbell Park No. 2 housing estate; U.D.C. surveyor.

Kettering.—Flats (36), Windmill Avenue; borough architect.

Lichfield.—Houses (41), Atherstone Street redevelopment, Fazeley; clerk, Rural Council House.

Multi-storey flats on sites at Dovehouse Fields, Lombard Street and Windmill Lane; D. Oglesby, city engineer, Guildhall.

London.—Chest clinic at Western Hospital, Fulham; Higgs & Hill, Ltd., builders, Crown Works, South Lambeth Road, S.W.8.

Flats and maisonnettes (68), Bazeley Street, Poplar; borough engineer.

Middlesbrough.—Houses (100) and flats (400), Hilda clearance area; borough engineer.

Mill Hill.—Two-storey block of offices, Bunns Lane; J. S. & F. Folkard (London), Ltd., 22, The Broadway, London, N.W.7.

Mitcham.—Factory in Willow Lane; F. L. Pryor, 189, Manor Road.

Morpeth. — County secondary school (£100,000); T. Armstrong, Robson Street, Newcastle-on-Tyne.

Newcastle-on-Tyne. — Secondary boys' school; city architect, 18, Cloth Market.

Northants.—Secondary modern school at Deanshanger for County Council; H. C. Janes, Ltd., Luton.

[*Continued on next page*

Work in Prospect (*Continued*)

Northern Ireland.—Public service vehicle examination station, Hastings Street, Belfast; F. H. Kerr & Co., Ltd., builders, 81, Ladas Drive, Belfast.

Primary school, Knockbreda, Belfast; McCarthy & Lilburn, surveyors, Scottish Provident Buildings.

Factory at Castlereagh Site No. 11 for Short Bros. & Harland, Ltd.; Ferguson & McIlveen, architects, 6, University Street, Belfast.

Factory at Kitchen Hill, Lurgan, Co. Armagh, for the Ministry of Commerce; Houston & Beaumont, architects, 9, Market Street, Lurgan.

Penrith.—Houses (98) on Scaws estate, Scaws Drive, Elm Terrace and Eden Mount; F. Birkbeck, U.D.C. surveyor, Town Hall.

Reading.—Sick hospital and admission unit, Borocourt Hospital; Oxford Regional Hospital Board, 43, Banbury Road, Oxford.

Redcar.—Bus station; borough engineer.

Rugby.—Police station, Rugby/Coventry Road site, for County Standing Joint Committee; G. R. Barnsley, county architect, Shire Hall, Warwick.

Ruislip-Northwood.—Flats (122) on sites at Diamond Road and Victoria Road, South Ruislip; Edward S. Saywell, clerk to U.D.C., Council Offices, Northwood, Mdx.

Salford.—Houses and flats (40), Lancaster Road area; R. Ribblesdale Thornton, town clerk, Town Hall, 3.

Scunthorpe. — Development of Ashby Market site; public lighting depot, East Common Lane; borough surveyor, Municipal Offices, 34, High Street.

Sleaford.—Foundry; Neville Foundry Co., Ltd., Harrison Street, Holmes, Rotherham.

South Shields.—Clothing factory at Simonside; J. Barbour & Sons, Market Place, South Shields.

Staffordshire.—Eight schools, 1957/58 programme (£564,000); director of education, Green Hall, Lichfield Road, Stafford.

Sunderland.—Two infants' schools, Hylton Castle; borough architect.

R.C. church at Pennywell; J. Cummings, builder, Millfield, Sunderland.

Sutton Coldfield.—Secondary grammar school (£186,600) and county junior school (£54,200); education officer, Moat House, Lichfield Road.

Thornaby-on-Tees. — County modern school; Johns, Slater & Haward, architects, 32, Foundation Street, Ipswich.

Wakefield.—Church and hall, Arncliffe Road; R. A. Easdale & Son, architects, County Chambers, Castleford.

Hotel, Doncaster Road and Agbrigg Road; Simpson & Moxon, architects, Southgate Chambers.

Warrington. — Organic peroxide plant; Laporte Chemicals, Ltd., Baronet Works.

Wednesfield.—Shops and maisonnettes (11), Ashmore Park estate; T. Peacock, architect, 29, Bolton Road.

West Bromwich.—Factory and offices; Metal Closures, Ltd., Bromford Lane.

West Hartlepool.—Offices and shops in York Road and Lucan Street for the Pearl Assurance Co., Ltd.; Kitching and Co., 21, Albert Road, Middlesbrough.

Houses and flats (60); Tarslag, Ltd., builders, Bowesfield Lane, Stockton-on-Tees.

Weymouth and Melcombe Regis.—Flats (50), at Chapelhay; E. J. Jones, town clerk, Town Clerk's Office.

Whickham (Co. Durham).—Houses (165) for the U.D.C.; E. Jeffcock, Ltd., builders, 107, New Bridge Street, Newcastle-on-Tyne.

Worcester.—Houses (61), Warndon estate; city engineer, 22, Bridge Street.

Worthing.—Works, Clarendon Road; C. L. Bencard, Ltd., Minerva Road, London, N.W.10.

York.—Three blocks of flats, Navigation Road; Wm. Birch & Sons, Ltd., builders, Spen Lane.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged.

Monday, 26th November

BIRMINGHAM.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midland Radio and Telecommunication Group. "Electronics and Automation—Some Industrial Applications," by Dr. H. A. Thomas.

BRISTOL. — Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Utilisation Group. "Future Trends in Aircraft Electrical Systems," by Dr. D. C. Flack.

Royal Hotel, 7 p.m. I.E.S. Bath and Bristol Centre. "Lighting for Inspection," by H. E. Bellchambers.

LEEDS.—E.L.M.A. Lighting Service Bureau, 24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "My Most Interesting Lighting Job"; four short papers by S. Addison, J. W. Bessant, K. Graham, and H. Laycock.

The University, 7.30 p.m. Incorporated Plant Engineers, West and East Yorkshire Branch. "Electronics in Industry," by F. G. Totty.

MALVERN.—Winter Gardens, 6 p.m. I.E.E. Malvern and District Group. "Control and Instrumentation of a Nuclear Reactor," by A. B. Gillespie.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "Underground Lighting in Coal Mines," by Dr. C. D. J. Statham.

Tuesday, 27th November

COVENTRY. — Methodist Central Hall, Warwick Lane, 7 p.m. I.E.E. South Midland Graduate and Student Section. "Transistors and their Applications," by J. C. Vickery.

LEEDS.—7 p.m. I.E.E. North Midland Graduate and Student Section. Visit to R. W. Crabtree & Sons, Ltd.

LONDON. — Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6 p.m. Illuminating Engineering Society. "Blackpool Illuminations," by H. Carpenter.

The Institute, 85, Minories, E.C.3, 5.30 p.m. Institute of Marine Engineers, Joint Nuclear Marine Propulsion Panel. "Some Safety Considerations of Nuclear Power Reactors," by C. D. Boadle.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Supply Group. "Measurement of Steam Temperatures in Power Stations," by D. H. Lucas and M. E. Peplow.

University Electrical Engineering Dept., Oxford Road, 7 p.m. I.E.E. North-Western Graduate and Student Section. "Vacation Work Abroad," symposium of four short papers.

RUGBY.—College of Technology and Arts, 6.30 p.m. I.E.E. Rugby Sub-Centre. "Trends in the Development of Airborne Electrical Equipment," by R. H. Woodall, P. J. Daglish, and V. A. Higgs.

SWANSEA. — Brangwyn Hall, 6.30 p.m. I.E.E. West Wales (Swansea) Sub-Centre. Faraday Lecture on "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

Wednesday, 28th November

BRIGHTON.—The Technical College, 6.30 p.m. I.E.E. Southern Centre, ordinary meeting. "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late T. Lawrie (read by L. H. Dickerson).

BRISTOL.—University Engineering Laboratories, 7.15 p.m. Institution of Production Engineers, Western Region. "Some Engineering Problems Associated with the Experimental Atomic Reactor," by W. F. Wood.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre, district meeting. "An Approximate Method for finding the 'Best Linear Servo Mechanism,'" by Dr. H. H. Rosenbrock.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre, informal meeting. "Visit to Russia," by J. S. Pickles and R. J. Rennie.

HOVE.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "Motor Control Gear," by R. T. Mathieson.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Automatic Solution of Power-System Swing-Curve Equations," by C. Adamson, L. Barnes, and B. D. Nellis; "Electronic-Analogue-Computer Study of Synchronous-Machine Transient Stability," by A. S. Aldred and P. A. Doyle; and "Dynamic Operation of an a.c. Network Analyser," by S. Kaneff (read by I. McDonald).

At the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers, London Section. "Colour Television," by Dr. G. N. Patchett.

Royal Society of Arts, John Adam Street, Adelphi, W.C.2, 2.30 p.m. Alfred Bossom Lecture, "Air Conditioning of Buildings," by J. S. Hales.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, Corporation Road, 6.30 p.m. I.E.E. Tees-Side Sub-Centre Graduate & Student Section. Tees-Side Section chairman's address, "Automatic Voltage Stabilisers," by R. J. Weir.

NOTTINGHAM. — A.S.E.E. Nottingham Branch. Visit to Stanton Iron Works.

Thursday, 29th November

BRISTOL.—Colston Hall, 6.30 p.m. I.E.E. Western Centre. Faraday Lecture, "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

BIRMINGHAM.—Birmingham Exchange and Engineering Centre, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. "High-Voltage Technology and Insulation Engineering," by Dr. J. B. Higham.

CHELMSFORD.—Hoffmann's Social Hall, 7.30 p.m. Chelmsford Engineering Society. (Joint meeting with Institution of Mechanical Engineers.) "Application of Atomic Energy to Power Production," by Dr. S. C. Curran.

CHESTER. — Stafford Hotel, City Road, 7.15 p.m. Incorporated Plant Engineers, Merseyside and North Wales Branch. "Electrical Hazards," by D. A. Picken.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. "Differences of Opinion about Dimensions," by Professor R. O. Kapp.

Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Address by J. Eccles on his Russian visit.

SHEFFIELD. — Grand Hotel, 7.30 p.m. Incorporated Plant Engineers, Sheffield and District Branch. "Automation."

Friday, 30th November

LONDON.—Pepys House, 14, Rochester Row, Westminster, S.W.1, 7 p.m. Junior Institution of Engineers. Annual general meeting.

Burlington House, Piccadilly, W.1, 2.30 p.m. Royal Society. Anniversary meeting.

House of Commons. Society of Engineers. Annual dinner.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North-Eastern Graduate and Student Section. "Switchgear Sales and Contracts," by W. D. Goodwin and B. Lilley.

NOTTINGHAM. — Welbeck Hotel, Milton Street, 7.15 p.m. I.E.E. East Midland Centre. Dinner-dance.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre District meeting. "Human Engineering," by B. Shackel.

Friday, 30th November, to Sunday, 2nd December

SOUTHPORT.—Institution of Works Managers. National conference.

Saturday, 1st December

ILFORD.—Angel Hotel. A.S.E.E. North-East London Branch. Annual dinner.